EXHIBIT 5

Endangered Species Act Section 7(a)(2) Consultation
Biological Opinion & Magnuson-Stevens Fishery Conservation & Management Act Essential Fish Habitat Consultation

Consultation on the "Willamette River Basin Flood Control Project"

Action Agencies:	U.S. Army Corps of Engineers Bonneville Power Administration U.S. Bureau of Reclamation
Consultation Conducted by:	NOAA's National Marine Fisheries Service (NMFS) Northwest Region
NOAA Fisheries Log Number:	F/NWR/2000/02117
Date Issued:	July 11, 2008
Issued by:	D. Robert Lohn Regional Administrator

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4 ENVIRONMENTAL BASELINE

ACRONYMS & ABBREVIATIONS

Action Agencies	USACE, BPA, and Reclamation
AM	annual milestones
AFS	American Fisheries Society
APA	Administrative Procedure Act
BA	Biological Assessment submitted by the Action Agencies to NMFS and USFWS on April 26, 2000
BIA	Bureau of Indian Affairs
BKD	bacterial kidney disease
BLM	U.S. Bureau of Land Management
BMP	best management practice
BPA	Bonneville Power Administration
BRT	Biological Review Team
CAP	Continuing Authorities Program
CBFWA	Columbia River Basin Fish & Wildlife Authority
cfs	cubic feet per second
CHARTS	Critical Habitat Analytical Review Teams
COP	configuration/operation planning
CPEC	Construction Projects Environmental Coordinating Committee
CR	Columbia River
CRFM	Columbia River Fish Mitigation
CRHRP	Columbia River Hatchery Reform Project
CRITFC	Columbia River Inter-Tribal Fish Commission
CSOs	combined sewer overflows
CTGR	Confederated Tribes of the Grand Ronde Community of Oregon
CTSI	Confederated Tribes of the Siletz Indians
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CTWS	Confederated Tribes of the Warm Springs Reservation
CWA	Clean Water Act
CWC	Calapooia Watershed Council
CWTs	Coded wire tags
DC	direct current
DDR	detailed design report
Defendants	NMFS, USFWS, USACE, and Reclamation
DEQ	Oregon Department of Environmental Quality
DO	Dissolved Oxygen
DPS	distinct population segment

DQA	Data Quality Act
ECC	Environmental Coordinating Committee
EFH	essential fish habitat
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionarily significant unit
EWEB	Eugene Water & Electric Board
FCRPS	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
FL	fork length
FM	Flow Management Committee
FMEP	Fisheries Management & Evaluation Plan
FPHM	Fish Passage and Hatchery Management Committee
FPMP	Fish Passage and Management Plan
fps	feet per second
GBT	gas bubble trauma
GI	General investigations
gpm	gallons per minute
HD	House Document
HGMP	Hatchery Genetic Management Plan
HSRG	Hatchery Scientific Review Group
HUC	Hydrologic Unit Code
HUC5	Hydrological Unit Code (at the fifth field scale, for example)
ICTRT	Interior Columbia TRT
IHN	Infectious Hematopoietic Necrosis
IHOT	Integrated Hatchery Operations Team
IM	interim milestones
ISAB	Independent Science Advisory Board
IT	incidental take
ITS	Incidental take statement
LCFRB	Lower Columbia Fish Recovery Board
LCR	Lower Columbia River
LGMSC	Lower Granite Migration Study Steering Committee
LTWC	Long Tom Watershed Council
LWD	large woody debris
MAF	millions of acre feet
MCR	Middle Columbia River
MHHW	mean higher high waters
MM	major milestone

MPG	major population groups
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MW	megawatts
NCBC	North Coast British Columbia
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NOAA	National Oceanic & Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPPC	Northwest Power Planning Council
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NTP	natural thermal potential
NTU	Nephelometric Turbidity Units
O&M	operations and maintenance
OAR	Oregon Administrative Rules
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OFC	Ocean Fish Commission
Opinion	this Biological Opinion
OPRD	Oregon Parks & Recreation Department
OWQI	Oregon Water Quality Index
OWRD	Oregon Water Resources Department
PA	Proposed Action
PAC	post-authorization change
PAH	Polynuclear aromatic hydrocarbons
PAS	Planning Assistance to States
PCE	primary constituent element
PDO	Pacific decadal oscillation
PFMC	Pacific Fishery Management Program
PGE	Portland General Electric Company
PIT-tag	Passive integrated transponder – tag
Plaintiffs	Willamette Riverkeepers and Northwest Environmental Defense Center
PNERC	Pacific Northwest Ecosystem Research Consortium
PNI	proportion of natural influence
PST	Pacific Salmon Treaty
RCC	USACE Northwest Division's Reservoir Control Center
Reclamation	U.S. Bureau of Reclamation
RER	Rebuilding Exploitation Rate

RM	River mile
RM&E	research, monitoring, and evaluation
RO	regulating outlet
RPA	reasonable and prudent alternative
RPM	reasonable and prudent measure
RSW	removable spillway weirs
SCAB	Steelhead and Chinook above Barriers Committee
SEAK	Southeast Alaska
Services	NMFS and USFWS, collectively
SIWG	Species Interaction Work Group
SLOPES	Standard Local Operating Procedures for Endangered Species
SOI	Southern Oscillation Index
SOP	standard operating procedure
SR	Snake River
SRP	Sustainable Rivers Project
STEP	Salmon and Trout Enhancement Project
Supplemental BA	Supplemental Biological Assessment submitted by the Action Agencies to NMFS and USFWS on May 31, 2007
SWCD	Santiam Water Control District
T&C	terms and conditions
TDG	total dissolved gas
TL	total length
TMDL	total maximum daily load
TNC	The Nature Conservancy
TRT	technical recovery team
TU	temperature unit
UCR	Upper Columbia River
UNREG	unregulated conditions
USACE	U.S. Army Corps of Engineers
USBR	US Bureau of Reclamation
USDA	US Department of Agriculture
USDI	US Department of Interior
USEPA	US Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWR	Upper Willamette River
VSP	viable salmonid populations
WLCTRT	Willamette/Lower Columbia Technical Recovery Team

WATER	Willamette Action Team for Ecosystem Restoration
WCP	Willamette Conservation Plan
WCSBRT	West Coast Salmon Biological Review Team
WFOP	Willamette Fish Operations Plan
WNF LRD	Willamette National Forest Lowell Ranger District
WNF	Willamette National Forest
WQMP	Water Quality Management Plan
WQTC	Water Quality and Temperature Control Committee
WRDA	Water Resources Development Act of 1950
WRI	Willamette Restoration Initiative
WTC	water temperature control
Yakama	Yakama Indian Nation

Chapter 1
Introduction

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1 INTRODUCTION

1.1 OBJECTIVES

This Biological Opinion (Opinion) is the result of an interagency consultation under Section 7(a)(2) of the Endangered Species Act (ESA) on the effects of the configuration, operations, and maintenance of the Willamette Valley Project (Willamette Project) on 13 listed species of Pacific salmon and steelhead, North American green sturgeon of the Southern DPS, and Southern Resident killer whale DPS. There are three Federal Action Agencies in this consultation because each plays a role in the Willamette Project. The U.S. Army Corps of Engineers (USACE) operates and maintains the 13 multipurpose dams and maintains about 43 miles of revetments in the upper Willamette basin; Bonneville Power Administration (BPA) markets power generated at some of the Willamette Project dams; and the U.S. Bureau of Reclamation (Reclamation) sells a portion of the water stored in Project reservoirs for irrigation purposes.

The National Marine Fisheries Service (NMFS) is responsible for administration of the ESA with respect to anadromous salmonids, green sturgeon, and killer whales. Section 7(a)(2) of the ESA requires Federal agencies to ensure that their actions do not jeopardize the continued existence of listed species or adversely modify designated critical habitat. To "jeopardize the continued existence of" means to engage in an action that reasonably is expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild, by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

The Action Agencies submitted a Biological Assessment (BA) (USACE 2000) to NMFS and U.S. Fish and Wildlife Service (USFWS, and collectively with NMFS, the Services) on April 26, 2000, and a Supplemental Biological Assessment (Supplemental BA) (USACE 2007a) on May 31, 2007, requesting consultation on the effects of the Willamette Project on species listed as threatened or endangered under the ESA, and on their critical habitat. The Action Agencies' Proposed Action consists of the continued operation and maintenance of the Willamette Project, which provides flood control, hydropower generation, water quality, water for irrigation, and other project purposes, including fisheries conservation and recreation. As part of the Proposed Action, the Action Agencies propose to reduce adverse effects on ESA-listed species by releasing minimum flows and reducing Project ramping in tributaries below dams; maintaining minimum flows in the mainstem Willamette River; constructing, operating, and maintaining fish collection and passage facilities at priority sites above and below Project dams; operating, improving, and maintaining Project hatcheries; and carrying out a series of research, monitoring, and evaluation actions to assess the effectiveness of the mitigation measures. The Proposed Action is described in more detail in Section 2 of this document and in the Action Agencies' BA (USACE 2000) and Supplemental BA (USACE 2007a), which are incorporated herein by reference as the complete version of the proposed action for this consultation.

The objectives of this Opinion are: (1) to determine the effects of the Proposed Action on 13 salmon evolutionarily significant units (ESUs) and steelhead distinct population segment (DPS), as well as the Southern DPS of North American green sturgeon (*Acipenser medirostris*), and Southern Resident killer whales (*Orcinus orca*), and (2) to determine if the Proposed Action is

likely to jeopardize the continued existence of these ESA-listed species under NMFS' jurisdiction, or adversely modify or destroy designated critical habitat for these species. Because there are multiple ESA-listed species are affected by the proposed action, and some of these are under USFWS jurisdiction, the Action Agencies consulted jointly with the Services. However, USFWS and NMFS wrote separate Biological Opinions.

This Opinion and the incidental take statement were prepared by NMFS in accordance with the ESA of 1973 (16 USC 1531 et seq.) and implementing regulations at 50 CFR 402. The analyses in this Opinion are based on NMFS' review of the best available scientific and commercial information. In this Opinion, NMFS concludes that the Proposed Action is likely to jeopardize the continued existence of Upper Willamette River (UWR) Chinook salmon and UWR steelhead, and to adversely modify or destroy designated critical habitat for these species. NMFS also concludes that the Proposed Action is likely to adversely affect, but not likely to jeopardize, the continued existence of the other 11 species of Interior and Lower Columbia Basin salmon and steelhead. Additionally, NMFS concludes that the Proposed Action is not likely to adversely modify or destroy designated critical habitat for the ten Interior and Lower Columbia Basin species for which it has been designated. Because the conclusion of this Opinion is that the Proposed Action jeopardizes two of the listed species of salmon and steelhead under NMFS' authority, NMFS developed and provides a reasonable and prudent alternative (RPA) to ensure their survival with an adequate potential for recovery. NMFS determines that the RPA and Proposed Action combined are not likely to adversely affect the Southern Resident killer whale DPS or the Southern DPS of North American green sturgeon, or to destroy or adversely modify critical habitat designated for the Southern Resident killer whale.

NMFS is also responsible for consultations conducted under Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) regarding essential fish habitat (EFH) consultation requirements. Section 305(b)(2) of the MSA requires Federal agencies to consult with NMFS if their actions may adversely affect EFH. Added to this Opinion is NMFS' assessment of whether the Proposed Action may result in adverse effects on EFH, and EFH conservation recommendations provided under Section 305(b)(4) of the MSA. NMFS prepared the EFH consultation in accordance with Section 305(b) of the MSA (16 USC 1855(b)) and implementing regulations at 50 CFR 600 subpart K.

The administrative records for both the ESA and MSA consultations are on file at NMFS' Northwest Regional Office in Portland, Oregon.

1.2 CONSULTATION PROCEDURAL HISTORY

1.2.1 ESA Consultation on Willamette Project Operations

Discussions between the USACE, USFWS, and NMFS on the ESA Section 7(a)(2) consultation requirements for the Willamette Project began in early 1999, shortly before UWR Chinook salmon *(Oncorhychus tshawytscha)* and UWR steelhead *(O. mykiss)* were listed (on March 24 and March 25, 1999, respectively [NMFS 1999a and 1999b]). A letter from USFWS to the USACE, dated February 9, 1999, outlined the issues that these two agencies had agreed should be covered in a single BA for a Section 7(a)(2) consultation. A letter from NMFS to the

USACE, dated February 25, 1999, provided additional guidance concerning the types of information to be included in the BA for UWR Chinook salmon and UWR steelhead.

On March 26, 1999, USACE sent a letter to NMFS requesting a species list for the Willamette Basin, which NMFS provided on March 30, 1999. Over the next year, the Services worked closely with USACE and its contractor to develop the BA for the Willamette Project. The Services and the USACE, in collaboration with the State of Oregon, also developed an approach to spring and early summer flow management that could be implemented while consultation was underway (ODFW 2000).

In April 2000, the USACE transmitted the 2000 BA (USACE 2000) to the Services and requested initiation of ESA Section 7 consultation on the impacts of the Willamette Project and maintenance of 43 miles of revetments on ESA-listed species. The proposed action contained in the 2000 BA was based on operation of the Willamette Project prior to the ESA-listing of UWR Chinook salmon and UWR steelhead in 1999. The 2000 BA concluded that the proposed action was "likely to adversely affect" several fish species and one plant species. On the basis of this finding, the USACE requested formal consultation with the Services. The BPA and Reclamation joined the USACE as Action Agencies for this Section 7 consultation at this time.

The Services provided a preliminary Federal review draft of a joint Biological Opinion to the Action Agencies on September 22, 2000. The analysis in the draft Opinion concluded that the continued operation of the Willamette Project was likely to jeopardize the continued existence of UWR Chinook salmon and UWR steelhead, and was likely to adversely modify designated critical habitat for the two species. When the draft was released, the USFWS had not completed its analysis of the Project's effects on bull trout, thus a jeopardy/non-jeopardy conclusion for that species was not included. Because the draft Opinion concluded jeopardy for two species, it included a draft RPA to avoid jeopardy. The Action Agencies developed a set of combined comments on the Federal review draft, which the Services received on January 12, 2001.

On March 22, 2001, the Services provided a revised draft of the RPA to the Action Agencies. The Action Agencies responded with a consolidated set of comments on April 25, 2001. The Services and the Action Agencies met frequently throughout the summer and fall of 2001 to revise and refine the RPA.

By letter dated May 24, 2002, the Action Agencies submitted an amendment to the 2000 BA (USACE 2000) proposing to increase the volume of stored water that could be released from Project dams to accommodate new Reclamation water service contracts. The USACE proposed to add an additional 10,000 acre-feet to the total amount of storage immediately available for water service contracts, for a total of 95,000 acre-feet. The USACE determined that the amended action would result in insignificant incremental effects on listed species, and that the existing BA adequately described the effects of the action on listed species. NMFS replied on August 7, 2002, that it would adjust the scope of the ESA consultation to include this amendment to the water service contracting program, and advised Reclamation to ensure that any actions taken prior to issuance of the Opinion be taken in a manner consistent with section 7(d) of the ESA. Reclamation replied to the Services by letter, dated January 10, 2003, confirming its decision to resume full contracting activities for irrigation water service from the Willamette

Project. Reclamation stated that it would proceed to review, approve, and execute short-term contracts in a manner consistent with section 7(d) of the ESA.

In October 2002, the Services, USACE, BPA, and Reclamation formed a senior-level policy group, called the Managers' Forum, to address Willamette Project issues. This group met approximately monthly through the winter of 2003 to review the progress of the consultation, and to discuss and resolve outstanding issues.

Although the Services initially intended to prepare a single, jointly written Biological Opinion for the Willamette Project, the size and complexity of the consultation ultimately argued against this approach. The Services decided in February 2003, to write two separate Biological Opinions. Despite this change, the Services have still considered this to be a joint consultation, and continued to coordinate between themselves.

By letter dated July 25, 2003, NMFS submitted a revised draft jeopardy Opinion, Chapters 1 through 8, to the Action Agencies for review and comment. On April 26, 2004, NMFS provided a preliminary revised draft RPA. On December 28, 2004, the Action Agencies provided consolidated comments on the NMFS revised draft Opinion, Chapters 1 through 8, identifying a number of key areas of concern that the Action Agencies believed should be resolved before completing consultation.

1.2.2 ESA Consultation on Willamette Project Hatcheries

On March 29, 2000, the USACE and BPA requested initiation of Section 7(a)(2) consultation on the impacts of the artificial propagation programs in the Willamette Basin on listed UWR Chinook salmon and UWR steelhead. On July 14, 2000, NMFS issued a *Biological Opinion on the Impacts from Collection, Rearing, and Release of Salmonids Associated with Artificial Propagation Programs in the Upper Willamette Spring Chinook and Winter Steelhead Evolutionarily Significant Units* (NMFS 2000a; hereinafter called the 2000 Hatchery Opinion), which provided an incidental take statement (ITS) to the USACE and BPA for operation of the hatchery mitigation programs in the Willamette Basin through September 30, 2003. Since expiration of the 2000 Hatchery Opinion, the Action Agencies worked with NMFS to put in place a new biological opinion, as described below.

1.2.3 Merging Hatcheries & Project Operations into a Single Consultation, Development of the 2007 Supplemental BA, and Completion of the NMFS Opinion

On January 3, 2006, the USACE notified the Services of the Action Agencies' decision to prepare a revised proposed action and supplement the 2000 BA. The Action Agencies proposed that the hatchery and Willamette Project consultations be merged because they had many related and overlapping actions. The revised proposed action integrated hatchery operations and recommendations for hatchery reform described in the Oregon Department of Fish and Wildlife's (ODFW) Hatchery Genetic Management Plans (HGMPs). Also, it incorporated measures to be consistent with NMFS' Hatchery Listing Policy (NMFS 2005a), which clarifies that any hatchery-origin population that is part of the same ESU or DPS as a listed natural-origin

population must also be listed under ESA. The Action Agencies proposed to include in the Supplemental BA certain structural measures they had the authority to implement, such as replacing hatchery fish collection facilities located at the base of some of the dams, which were not originally equipped to handle ESA-listed fish. In addition to hatchery operations, the Action Agencies decided to revise the proposed action for the Willamette Project to more accurately reflect current operations, particularly the mainstem and tributary flow modifications implemented since 1999, and to address other issues that came up since 2000.

Throughout 2006 and early 2007, the Action Agencies and Services met regularly to clarify and add detail to measures that would be included in the revised proposed action. The Action Agencies issued the Supplemental BA (USACE 2007a) on May 31, 2007.

On July 17, 2007, NMFS submitted a letter to the Action Agencies requesting additional information on actions proposed in the Supplemental BA. While the Action Agencies were preparing additional analyses in response to NMFS' request, NMFS organized a series of technical and senior policy meetings to clarify outstanding issues. These meetings with the Action Agencies and USFWS, which were facilitated, took place from September 2007 through January 2008 and culminated in general agreement on the terms of a RPA.

During the period, October 2007 through June 2008, the Action Agencies provided the following additional information to NMFS to assist in completion of this Opinion:

- October 2, 2007 letter from the USACE to NMFS, providing reference material and Project operations' modeling results;
- December 14, 2007 letter from USACE to NMFS, identifying specific fish passage and water quality measures that had been agreed to in the 2007 facilitated meetings;
- January 30, 2008 letter from USACE to NMFS, clarifying the measures identified in the December 14, 2007 letter;
- June 2, 2008 email from Alan Donner, USACE, to NMFS, providing additional Project operational and flow modeling analyses in response to NMFS' request; and
- June 17, 2008 letter from USACE, on behalf of the Action Agencies, to NMFS, providing analyses of the effects of the revised proposed action on North American green sturgeon and Southern Resident killer whale, and an analysis of effects of the proposed action taking into consideration climate change. The Action Agencies also requested EFH consultation with NMFS, as required by the MSA.

From January through April, 2008, NMFS was revising its earlier draft Opinion to evaluate the revised proposed action described in the Supplemental BA (USACE 2007a), as well as the subsequently provided additional information, as described in the previous paragraph, and the draft RPA. During this same period, NMFS participated in two staff-level meetings with Oregon Water Resources Department (OWRD), Reclamation, BPA, and USACE to seek clarification on possible mechanisms to protect flows released from Project reservoirs for fish purposes from out-of-stream diversion by holders of Oregon water rights for natural flows. In this Opinion, NMFS includes an RPA measure that requires the Action Agencies to take actions and provide information to OWRD to assist in the process of protecting flows for fish purposes.

NMFS issued a draft Opinion on April 30, 2008 for review by the Action Agencies. In addition to written comments from the Action Agencies, NMFS received verbal comments at 4 days of meetings held with them and USFWS in early May, 2008. NMFS considered Action Agencies' comments, as well as verbal comments received from several Tribes (see section 1.3 below regarding consultation with affected Tribes), in the preparation of this final Opinion, issued July 11, 2008.

1.2.4 Litigation & Settlement

On September 20, 2007, Willamette Riverkeepers and Northwest Environmental Defense Center (plaintiffs) filed a complaint in the United States District Court for the District of Oregon, against NMFS, USFWS, USACE and Reclamation (defendants) alleging violations of the ESA, Administrative Procedure Act (APA) and the National Environmental Policy Act (NEPA) in connection with this consultation. Defendants filed their answer on November 16, 2007. Plaintiffs and Defendants agreed to a Stipulated Settlement Agreement, dated February 26, 2008. The Settlement Agreement includes, among other things, agreement by the Services to complete their Opinions by July 11, 2008.

1.3 CONSULTATION WITH AFFECTED INDIAN TRIBES

The Secretarial Order: American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and Endangered Species Act (SO) clarifies the responsibilities of the Departments of Commerce and the Interior when actions or regulations under the ESA "may affect Indian lands, tribal trust resources, or the exercise of American Indian tribal rights." The SO further states, "The Departments will carry out their responsibilities under the Act in a manner that harmonizes the federal trust responsibilities to tribes, tribal sovereignty, and statutory missions of the Departments." Specifically, NMFS is directed to solicit relevant information from the tribes should they wish to offer any, and to encourage Action Agencies to include affected Tribes in their consultation process.

On October 3, 2001, NMFS contacted tribal fisheries managers alerting them to the Willamette Project ESA consultation and proposing to hold an informational meeting with them. The following Tribes were contacted: Confederated Tribes of the Warm Springs Reservation (CTWS), Yakama Indian Nation (Yakama), Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Nez Perce Tribe, Confederated Tribes of Siletz Indians (CTSI), and Confederated Tribes of the Grand Ronde Community of Oregon (CTGR). On November 13, 2001, the Services and Action Agencies met jointly with technical representatives of CTSI, CTWS, and CTGR for initial coordination regarding the scope and content of the Willamette Project ESA consultation. Representatives from all three Tribes expressed interest in the consultation, especially as it might affect harvest of salmon and Pacific lamprey (*Lampetra tridentata)* at Willamette Falls.

By letters to tribal council leaders dated February 14, 2008, NMFS notified the tribes listed above, as well as the Columbia River Inter-Tribal Fish Commission (CRITFC), each of whom may potentially have an interest in the Proposed Action, of its ESA consultation regarding the Willamette Project. Copies of these letters were also sent to designated contact personnel in their

respective tribe's natural resources or fisheries programs. The letters summarized the purpose of this consultation and solicited information, traditional knowledge or comments the tribes might provide to help in the consultation. The letters also invited the tribes to participate in an informational meeting about the Willamette Project and this consultation, hosted jointly by the Services and Action Agencies, to be held on May 5, 2008. Subsequently, NMFS staff contacted designated personnel at each tribe to discuss the proposed action and to seek the tribe's perspective on potential effects of the proposed action on any Tribal resources and rights.

Tribal biologists or attorneys, or both, from the CTWS, CTUIR, CTSI, and CTGR attended the May 5, 2008 meeting. The Tribal Council Chairman of CTWS also participated. Additionally, technical staff from CRITFC and U.S. Bureau of Indian Affairs (BIA) were present. At that meeting, the Action Agencies described the Willamette Project and conservation measures proposed in the Supplemental BA (USACE 2007a). NMFS and USFWS presented summaries of each agency's respective draft biological opinions, including the RPA measures that NMFS was proposing to include in its jeopardy opinion for UWR Chinook salmon and UWR steelhead. Tribal representatives were invited to ask questions and provide information and verbal comments.

Tribal representatives at the May 5, 2008 meeting requested an opportunity to review the draft Opinion. In response, NMFS invited tribal representatives to view copies of the draft Opinion at NMFS' Northwest Regional Office in Portland, Oregon. On May 22, 23, and 27, tribal representatives from CTUIR, CTWS, CTGR, and CRITFC reviewed the April 30, 2008 draft Opinion. NMFS staff were available to answer questions and listen and respond to verbal comments.

Following this opportunity to review the draft opinion, CTUIR and CRITFC representatives requested an informal meeting with NMFS staff to discuss their concerns. This meeting was held on June 2, 2008. CTWS, CTUIR, YIN, and CRITFC representatives requested another informal meeting with NMFS policy and technical staff, which was held on June 19, 2008. At this meeting, tribal representatives discussed three primary issues: tribal participation and roles in implementation structure, lamprey protection, and tribal participation in studies and decisions related to fish passage, flows, and other RPA measures. NMFS responded that the RPA coordination implementation process included tribal participation. Additionally, NMFS indicated that it would propose consideration of lamprey protection and tribal participation in studies and other measures in its recommended conservation measures.

1.4 Listed Species Occurring Within the Action Area

There are 13 ESA-listed salmon and steelhead species that may be affected by the Proposed Action. Species that may be affected by this action include: UWR Chinook salmon (*O. tshawytscha)*, UWR steelhead (*O. mykiss*), Lower Columbia River (LCR) Chinook salmon, LCR coho salmon *(O. kisutch),* LCR steelhead, Middle Columbia River (MCR) steelhead, Columbia River (CR) chum salmon *(O. keta)*, Snake River (SR) spring/summer Chinook salmon, SR fall Chinook salmon, SR sockeye salmon *(O. nerka)*, SR steelhead, Upper Columbia River (UCR) spring Chinook salmon, and UCR steelhead. The listing status and critical habitat designations for each of the species that may be affected by the Proposed Action are identified in Table 3-1.

Except for LCR coho salmon, critical habitat has been designated for all of the anadromous fish potentially affected by the Proposed Action.

Southern Resident killer whales are listed as endangered and the Southern DPS of North American green sturgeon is listed as threatened under the ESA. Both species may be affected by the actions discussed in this consultation. After conducting the analyses included as Appendices A and B to this Opinion, NMFS determines that the Proposed Action and the RPA are not likely to adversely affect either species or critical habitat designated for the Southern Resident killer whale.

1.5 APPLICATION OF ESA SECTION 7(A)(2) STANDARDS – ANALYTICAL APPROACH

This section describes NMFS' approach to applying the standards for determining jeopardy, and destruction or adverse modification of critical habitat that are set forth in the ESA's Section 7(a)(2) and in 50 CFR 402.02 (the consultation regulations). Additional details regarding this analysis are provided by the *Endangered Species Consultation Handbook*, issued jointly by the Services (USFWS and NMFS 1998). In conducting analyses of actions under the ESA's Section 7 and as directed by the consultation regulations, NMFS follows these steps:

- Identifies the action area based on the action agency's description of the proposed action, and describes the proposed action (Section 2 of this Opinion).
- Evaluates the current status of the listed species with respect to biological requirements indicative of survival and recovery and the primary constituent elements (PCEs) of any designated critical habitat (Section 3 of this Opinion).
- Evaluates the relevance of the environmental baseline in the action area to the species' biological requirements and the current status within the action area, as well as the status of any designated critical habitat (Section 4 of this Opinion).
- Determines whether the proposed action reduces the abundance, reproduction, or distribution of the species, or negatively alters any PCEs of designated critical habitat within the action area (Section 5 of this Opinion).
- Determines and evaluates any cumulative effects within the action area (Section 6 of this Opinion).
- Evaluates whether the effects of the proposed action, taken together with cumulative effects and the effects within the environmental baseline, can be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the affected species, or are likely to destroy or adversely modify critical habitat (Section 7 of this Opinion; see CFR 402.14(g)).

The jeopardy standard is survival with an adequate potential for recovery. We apply this standard for the Willamette consultation in such a way that we determine the effects of the Proposed Action, analyze whether these effects appreciably reduce the likelihood of the species survival and recovery, and determine whether the proposed action contributes to survival with an adequate potential for recovery. If, in completing the last step of the analysis, NMFS determines that the action is likely to jeopardize the ESA-listed species or adversely modify critical habitat,

NMFS must identify a reasonable and prudent alternative (RPA) to the proposed action that avoids jeopardy or adverse modification of critical habitat by contributing towards the species survival with an adequate potential for recovery. (see CFR §402.02). In making these determinations, NMFS must rely on the best available scientific and commercial data.

In the critical habitat analysis, NMFS determines whether the proposed action will destroy or adversely modify designated or proposed critical habitat for ESA-listed species by examining any change in the conservation value of the PCEs of that critical habitat. This analysis focuses on statutory provisions of the ESA, including: Section 3, which defines "critical habitat" and "conservation"; Section 4, which describes the designation process; and Section 7, which sets forth the substantive protections and procedural aspects of consultation. This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.2. Instead, NMFS relies upon the Hogarth memo (NMFS 2005b).

1.6 TERM OF THE OPINION

The term of this PA and the Opinion and incidental take statement is through 2023, and encompasses completion of certain major structures intended to improve fish passage and water quality at high priority Project dams, and includes monitoring and evaluations necessary to design effective structures and assess measures in the Proposed Action. Additional major structures and other measures may be in completed after 2023, but steps towards their completion are part of this consultation. NMFS may choose, based on the best available information, to extend this Opinion and the incidental take statement at the request of the Action Agencies. NMFS will determine whether an extension is appropriate, and if so, NMFS will also determine the appropriate length of the extension.

1.7 CONCLUSIONS

In this Opinion, NMFS concludes that the Proposed Action would jeopardize the continued existence of UWR Chinook salmon and UWR steelhead, and would destroy or adversely modify their critical habitat because it does not adequately address adverse effects of the dams, revetments and hatcheries on listed fish and their habitat, factors that are suppressing the viability of both species and are contributing to the high risk of extinction for UWR Chinook. NMFS therefore provided the Action Agencies with a Reasonable and Prudent Alternative (RPA), a package of measures that allows for the survival with an adequate potential for recovery for these two species. A number of the RPA measures will provide benefits in the short-term, reducing each species' short-term risk of extinction, including measures to improve downstream habitat by changing flows and temperature, updating hatchery operations and facilities, improving irrigation diversions and water contracts, upgrading fish collection facilities and outplanting procedures, and conducting habitat improvement projects. These measures will immediately (during the first one-to-seven years of this Opinion) improve population viability and reduce the short-term risk of extinction. This is especially important for UWR Chinook salmon, for which the risk of extinction is "high."[1] Project operations have had a key role in

[1] The Willamette/Lower Columbia Technical Recovery Team (WLCTRT) (McElhany et al. 2007) estimated the risk of extinction over 100 years for UWR Chinook ("high;" see Figure 3-5 in Section 3.2.1.3). The TRT did not estimate the species' short-term extinction risk.

degrading habitat conditions downstream, which in the North and South Santiam, South Fork McKenzie, and Middle Fork Willamette are the only areas still accessible to Chinook for spawning, incubation, and early rearing. The Action Agencies began new reservoir operations in 2000 to meet mainstem and tributary flow objectives for both listed Chinook and steelhead. These, and operations that began in 2005 at the new Water Temperature Control facility at Cougar Dam, are already able to have a positive influence on adult Chinook returns. Under the RPA, interim temperature control operations at Detroit will improve water temperatures in the North Santiam, increasing the survival of eggs, juveniles, and prespawning adults of both species and thus population productivity. All of these measures will reduce extinction risk in the short term as well as contributing to long-term viability.

The RPA includes a number of measures that will be completed in the second half of the term of the Opinion, the eighth to fifteenth years. These include three significant passage facilities at three dams and temperature control at a different dam, as well as other measures. These measures will contribute significantly to both species' survival and potential for recovery. The RPA also requires that the Action Agencies complete various research and monitoring efforts, feasibility studies, and where needed, environmental impact analysis. These evaluations will lead to the construction of facilities and adjustments in operations during the second half of the term of this Opinion that will ensure that conditions are significantly improved for all affected life stages of UWR Chinook and UWR steelhead. These will include further adjustments to flows, passage at three projects, and temperature control at another. The Action Agencies will adapt their operations to new information as well as physical habitat properties, including those related to climate change, as the information becomes available over the next 15 years.

Outside of the Willamette Basin, adverse effects of the Proposed Action are limited to very small changes in flows in the mainstem lower Columbia with slight to negligible effects on listed salmonids and their habitat. NMFS concludes that the Proposed Action does not jeopardize the continued existence of the other 11 species of Interior and Lower Columbia Basin salmon and steelhead, which are affected by the Proposed Action only in that portion of the action area. NMFS also concludes that the Proposed Action avoids any destruction or adverse modification critical habitat for the ten Interior and Lower Columbia Basin species for which it has been designated. NMFS determines that the Proposed Action and the RPA are not likely to adversely affect the Southern Resident killer whale DPS or the Southern DPS of North American green sturgeon, or to destroy or adversely modify critical habitat designated for the Southern Resident killer whale.

Chapter 4
Environmental Baseline

Section 4.1
General Baseline Perspective

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4 ENVIRONMENTAL BASELINE

SUMMARY OF ENVIRONMENTAL BASELINE

- Over the last century and a half, habitat degradation, hatchery influences, harvest rates and dams have adversely affected spring Chinook and winter Steelhead populations and their designated critical habitat.
- The quantity and quality of remaining spawning and rearing habitat has been significantly degraded by multiple factors. The dams have major impacts on both species in terms of flow, water temperature regime, downstream sediment and large wood transport, and channel complexity.
- The construction of the Willamette Project dams has blocked access to a substantial proportion of the historical habitat and has adversely affected habitats downstream. The best quality habitat is located in the headwater areas, with many of these areas not accessible to fish due to the impassable dams. The dams also have major impacts on both species in terms of flow, water temperature regime, downstream sediment and large wood transport, and channel complexity.
- Hatchery Chinook have significantly affected the genetic integrity of all Chinook populations. Hatchery fish spawning in the wild with natural-origin fish has been extensive.
- Fishery harvest levels were high in the past, but have now been reduced significantly. Harvest is no longer a limiting factor for Willamette Chinook and steelhead.

The "environmental baseline" for Biological Opinions is defined in the ESA section 7 implementing regulations as:

> "the past and present impacts of all Federal, state, or private actions and other human activities in an action area, the anticipated impacts of all proposed Federal projects in an action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process" (50 CFR §402.2)

The ESA Section 7 Consultation Handbook (USFWS and NMFS 1998) further states that the environmental baseline is:

> "an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem within the action area. The environmental baseline is a "snapshot" of a species' health at a specified point in time."

NMFS' analysis of conditions in the environmental baseline begins with a brief discussion of factors that affect multiple populations followed by discussions of conditions in each tributary basin, starting with the Middle Fork Willamette basin and progressing northward culminating with a discussion of conditions in and around the mainstem Willamette River, in the lower Columbia River, Estuary and plume.

4.1 General Basinwide Perspective

The Willamette River Basin (Figure 4.1-1) historically supported large numbers of spring Chinook and winter steelhead. The diversity of habitats, ranging from the cold, snow-melt headwater streams in the Cascade Mountains downstream to the meandering and highly complex Willamette River, produced diverse and productive populations of salmon and steelhead. Historical populations had multiple juvenile life history types and adults returned at higher ages than is currently the case (Willis et al. 1995). Juvenile salmon and steelhead reared in the headwater streams and the mainstem Willamette River. Juveniles emigrated to the ocean over a number of months, with spring and fall migrations predominating.

Over the last 150 years UWR Chinook salmon and UWR steelhead have been adversely affected by dams, habitat degradation, fishing, and interactions with hatchery-origin fish. In the late 1800s, fish harvest in the Lower Columbia River had the most profound effect on Willamette runs, already causing noticeable declines in run sizes by 1878 (Stone 1878). In the early 1900s, European colonization of the Willamette Basin increased rapidly, with associated development and natural resource extraction greatly affecting the quality of salmonid habitat. Discharge of pollution by timber and paper mills into the mainstem Willamette River was so severe that massive die-offs of aquatic species including salmon and steelhead were prevalent. The problem was severe and public outcry to clean up the mainstem Willamette began as early as the late 1930s.

Figure 4.1-1 Principal Corps of Engineers facilities in the Willamette Basin

The Draft Willamette Salmon and Steelhead Recovery Plan (ODFW 2007b) identifies the most important key and secondary limiting factors and threats impacting spring Chinook and winter steelhead in the Willamette Basin. Limiting factors are the physical, biological, or chemical conditions experienced by the fish that limit their natural production or VSP attributes (McElhany et al. 2000). Threats are activities that have an effect on the fish and/or the

environmental conditions they need to survive and reproduce. The limiting factors and threats are discussed in more detail for each of the populations, below. However, the following is a general summary of the key and secondary limiting factors and threats that have been identified in the Draft Recovery Plan (ODFW 2007b):

Spring Chinook Salmon

- Impaired access to habitat above hydropower/flood-control dams throughout the Willamette Basin.
- Direct mortality of juvenile fish associated with downstream passage through the hydropower/flood-control dams and reservoirs.
- Prespawning mortality of adult Chinook over-summering below the hydropower/flood-control dams.
- Hatchery Chinook interbreeding with natural-origin fish resulting in a risk of genetic introgression.
- Predation and competition with hatchery fish of all species.
- Altered water temperature regimes downstream of the hydropower/flood-control dams.
- Altered habitat conditions downstream of the hydropower/flood-control dams caused by reduced peak flows, reduced large woody debris, and reduced substrate recruitment.
- Altered habitat conditions in the tributaries caused by land management activities.
- Toxicity due to agricultural, urban, and industrial practices.
- Degraded estuarine habitat.

Winter Steelhead

- Altered habitat conditions caused by land management activities (timber, agricultural, urban).
- Toxicity due to agricultural, urban, and industrial practices in tributaries and mainstem Willamette.
- Impaired access to habitat above hydropower/flood-control dams throughout the Willamette Basin.
- Direct mortality of juvenile fish associated with downstream passage through the hydropower/flood-control dams and reservoirs.
- Hatchery fish interbreeding with natural-origin fish resulting in a risk of genetic introgression from use of an out-of-DPS stock (summer steelhead).
- Predation and competition with hatchery fish of all species.
- Altered water temperature regimes downstream of the hydropower/flood-control dams.
- Unscreened diversions create impediments and barriers to juvenile steelhead.
- Altered habitat conditions downstream of the hydropower/flood-control dams caused by reduced peak flows, reduced large woody debris, and reduced substrate recruitment.

- Degraded estuarine habitat.
- Interactions with non-native fish species.

4.1.1 Project Effects in the Environmental Baseline

4.1.1.1 Blockage of Upstream Habitats

From the late 1940s through the1960s, construction of 13 dams by the USACE blocked access to the majority of historical habitat for spring Chinook and, to a lesser extent, winter steelhead (Figure 4.1-2). Because these dams were high-head storage dams greater then 200 feet in height, volitional upstream fish passage (e.g. fish ladders) was considered to be infeasible and no fish passage facilities were built at most of the dams (USACE 2000). At some Project dams, traps were built to lift or transport adults upstream and simple collection devices for downstream juvenile migrants were used. Injury and mortality associated with these early systems greatly reduced the productivity of salmon and steelhead populations despite access to historical habitat above these dams. Fisheries managers tried to compensate for lost production with hatchery supplementation until improved passage facilities became feasible. From the 1960s to the present, as wild Chinook runs have precipitously declined, hatchery fish have made up a greater proportion of the returns. Human population growth and land development on the floodplain continued to increase, with the Willamette Basin now supporting approximately 75% of the human population of the state of Oregon. Habitat quantity and quality in the low elevation reaches below the dams has declined in response.

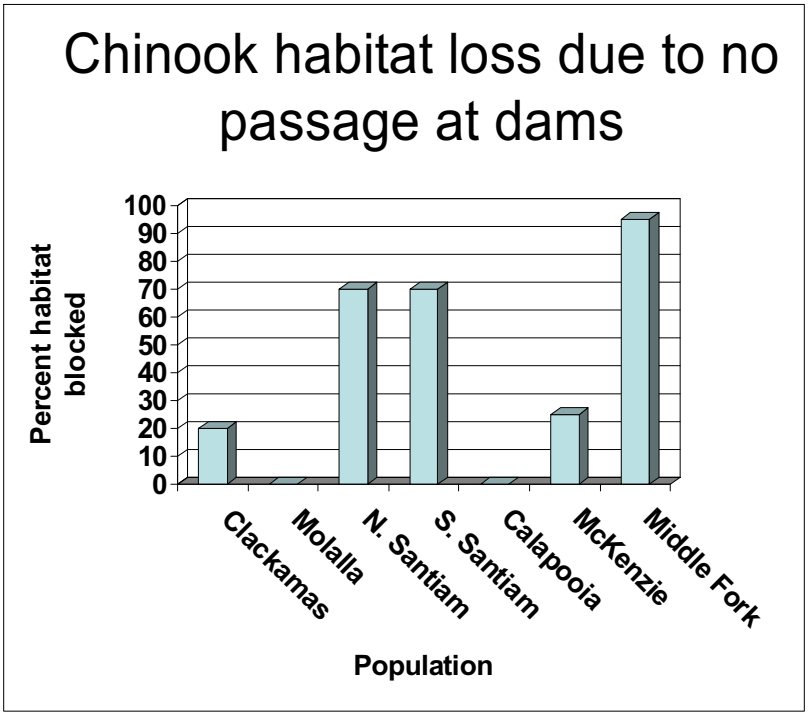

Figure 4.1-2 Percent of historic Chinook salmon spawning area in Willamette Basin blocked by impassable Federal dams in each population area. Estimates provided by USACE (2007a).

4.1.1.2 Flow Alteration

By seasonally putting water into storage and releasing it later in the year, the large water storage facilities of the Willamette Project have affected the streamflow characteristics of each affected tributary and the mainstem Willamette River. The Willamette Project's large storage facilities are drafted each fall for flood control and refilled each spring for other uses. The Project can also cause unusually large discharge changes over very short periods. These hydrologic effects seasonally modify fish habitat characteristics in the stream reaches downstream from these facilities.

These effects are discussed in detail in the stream-segment specific discussions below (Sections 4.2 through 4.11).

4.1.1.3 Water Quality

Water Temperature Effects
Water development influences water temperatures through storage, diversion, and irrigation return flows. These changes in water temperatures have significant implications for anadromous fish survival.

Among the primary water temperature effects of recent Willamette Project operations is a phenomena termed: thermal inertia. Thermal inertia refers to the tendency for the temperature of water released from a reservoir to temporally lag the temperature of incoming water (Figure 4.1-3). For example, in Figure 4.1-3, water coming into the reservoir (labeled "□ - above") warms by mid-summer and then begins to cool, while that flowing out of the reservoir (labeled "+ - below") lags behind by nearly 100 days, not reaching highest temperatures until fall.

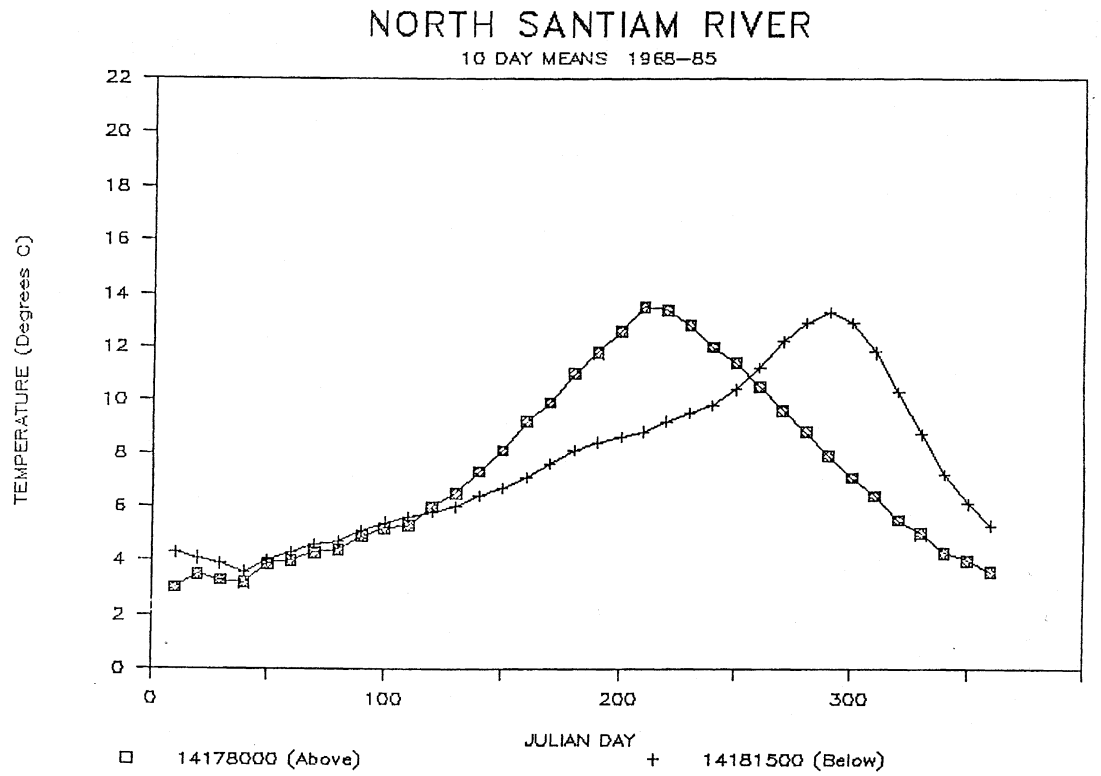

Figure 4.1-3 Water temperature changes caused by Detroit and Big Cliff reservoirs in the North Santiam River, 1968-1985.

Biological Effects

Thermal inertia changes the seasonal water temperature regime. Cooler water temperatures than normal in late-spring and early summer can delay upstream migration of UWR Chinook. For fall spawning species like UWR Chinook, warmer fall temperatures can delay spawning and accelerate incubation. Warmer fall temperatures can also exceed the thermal tolerance for incubating eggs, reducing viability. Eggs from spring spawning UWR steelhead develop more slowly at reduced temperatures. For both species, thermal inertia modifies emergence timing. Assuming that these fish are well adapted to the environment in which they evolved, such changes in emergence timing places the fish at a disadvantage. Ecological issues such as the abundance of predator and prey species changes through time. For example, an early-emerging Chinook alevin may have little to eat. Such thermal inertia effects may reduce the potential utility of habitat downstream from the dams and reduce the viability of the affected populations.

In 2003, EPA collaborated with NMFS and other regional resource managers to establish guidance for developing water quality standards. With regard to water temperature, the EPA reviewed the scientific literature and established recommended thresholds for a variety of salmonid life stage reactions (Table 4.1.-1).

Table 4.1-1 Summary of the EPA Water Temperature Guidelines and Potential Effects to Salmon. (Source: EPA 2003a).

LIFE STAGE	LIFE STAGE REACTION		THRESHOLD (˚C)
Adult	Lethal (1 week exposure)		21-22
	Migration Blockage		21-22
	Disease Risk	High	18-20
		Elevated	14-17
		Minimized	12-13
	Swim Performance	Reduced	>20
		Optimal	15-19
	Overall Reduction in Migration Fitness		>17-18
Spawning	Spawning Behavior Observed in the Field		4-14
Eggs & Incubation	Good Survival		4-12
	Optimal Incubation		6-10
	Reduced Viability of Gametes		>13
Emergence & Juvenile Rearing	Lethal (1 week exposure)		23-26
	Optimal Growth	Unlimited Food	13-20
		Limited Food	10-16
	Rearing Preference Temperature		10-17
	Impaired Smoltification		12-15
	Disease Risk	High	>18-20
		Elevated	14-17
		Minimized	12-13

Of particular concern in the mainstem Willamette River is water temperatures during the spring emigration of steelhead smolts (April – June). At water temperatures above 15 ºC a parasitic myxosporean, *Ceratomyxa shasta,* becomes highly virulent, and recent research has shown that

the probability of an outmigrating smolt returning as an adult is reduced when water temperatures exceed 15 ºC during outmigration (ODFW 2007b). Chinook salmon are somewhat more resistant to this disease but are also affected.

Global warming has increased average annual Columbia basin air temperatures by about 1 degree C over the past century, and water temperatures have been similarly affected (ISAB 2007). The influence of this and other large-scale environmental variations are discussed in Section 4.1.2 below.

Total Dissolved Gas

Spill at Project dams can cause downstream waters to become supersaturated with dissolved atmospheric gasses. Supersaturated total dissolved gas (TDG) conditions can cause gas bubble trauma (GBT) in adult and juvenile salmonids resulting in injury or death. Biological monitoring at nearby dams on the Columbia River shows that the incidence of GBT in both migrating smolts and adults remains between 1-2% when TDG concentrations in the upper water column do not exceed 120% of saturation. When those levels are exceeded, there is a corresponding increase in the incidence of signs of GBT symptoms. At times, TDG in Project dam discharges has exceeded 120% of saturation concentration.

4.1.2 Large-scale Environmental Variation

This section discusses inter-annual climatic variations (e.g. El Niño and La Niña), longer term cycles in ocean conditions pertinent to salmon survival (e.g., Pacific Decadal Oscillation), and ongoing global climate change and its implications for both oceanic and inland habitats and fish survivals. Because these phenomena have the potential to affect salmonid's survival over their entire range and multiple life stages, they are an area of substantial scientific investigation.

Salmonid population abundance is substantially affected by inter-annual changes in the freshwater and marine environments, particularly by conditions early in their life histories. Generally, the inland environment (including rivers, tributaries, and the associated uplands) is most favorable to salmon when there is a cold, wet winter, leading to substantial snowpack. This normally results in higher levels of runoff during spring and early summer, when many of the juvenile salmon are migrating to the ocean. The higher levels of runoff are associated with lower water temperatures, greater turbidity, and higher velocity in the river, all of which are beneficial to juvenile salmon. However, in years with exceptionally high snow pack and rain-on-snow events, severe flooding may constrain populations. The low return of Lewis River bright fall Chinook salmon in 1999, for example, has been attributed to flood events during 1995 and 1996.

Within the ocean environment, near-shore upwelling, which brings nutrients up from depth into the photic zone, is a key determinant of ocean productivity because it affects the availability of food for juvenile salmon at the critical time when they first enter the ocean. The upwelling results from ocean currents driven by spring and early summer winds which, in turn, result from oscillations in the jet stream that follow certain cycles. Within a year there are cycles of 20-40 days that affect upwelling and among years there are longer-lasting conditions, such as El Niño/La Niña, cycles of 2-3 years, and the Pacific Decadal Oscillation (PDO). The latter may have cycles of 30-40 years or more that influence upwelling.

Scheurell and Williams (2005) showed that the coastal upwelling index is a strong determinant of year-class strength and subsequent smolt-to-adult return ratios. The Northwest Fisheries Science Center currently monitors a number of ocean conditions and provides a forecast on their website for salmon returns to the Columbia River based on these and other observations.

In some instances, the inland conditions and ocean conditions appear to be correlated; that is, the same weather patterns producing a cold, wet winter with good snowpack and high spring runoff are also likely to bring the later winds that yield good upwelling and favorable feeding conditions in the ocean. However, it is also possible for inland and ocean conditions to diverge, and years have been observed where there have been favorable river conditions but poor ocean conditions, and vice versa.

While strong salmon runs are a product of both good in-river conditions and good ocean conditions, favorable ocean conditions appear to be especially important. For example, 2001 was the second-lowest flow year recorded on the Columbia River, but the near-shore temperatures were generally cool, observed ocean productivity was good, and resulting adult returns from the 2001 juvenile outmigration class were in the average or better range for most of the runs.

4.1.2.1 The Southern Oscillation Index, El Niño & La Niña

In an effort to predict the likely strength of the annual monsoons over India, which greatly affected human life through floods and famines, in the 1920s, Sir Gilbert Walker conducted extensive statistical analyses of long-term weather observations for many locations around the globe. Among his many findings was that deviations from long-term average seasonal differences in atmospheric pressure between the western Pacific and the eastern Pacific (typically Darwin, Australia, to Tahiti), were strongly correlated with subsequent climatic conditions in other parts of the globe. Walker termed these deviations, the "Southern Oscillation Index" (SOI). In general, substantial negative SOIs tend to correlate well with above average tropical sea-surface temperatures and positive SOIs tend to correlate with below average sea-surface temperatures, particularly in the eastern Pacific. Both have been found to have "teleconnections" to climatic and oceanic conditions in regions far distant from the south Pacific, including the Pacific Northwest. Although in modern usage a broader array of oceanic and atmospheric characteristics have been found to provide greater predictive power, these teleconnections between conditions in the south Pacific and subsequent climatic conditions elsewhere have come into routine use, including pre-season predictions of runoff in some portions of the Columbia basin.

Atmospheric conditions correlated with unseasonably warm south Pacific sea-surface temperatures are termed El Niños. El Niños typically last 6 to 18 months. Among the consequences are warmer near-surface ocean water temperatures along the U.S. west coast and generally warmer, drier weather in the inland Pacific Northwest, particularly during the winter. When winds do not blow south, the forces that create upwelling off the U.S. coast are reduced, as are nutrient inputs to the euphotic (well lit, near surface) zone, reducing near-shore ocean productivity. This reduction in ocean productivity has been shown to reduce juvenile salmon

growth and survival (Scheurell and Williams 2005). Warmer surface waters can also change the spatial distribution of marine fishes, including potential predators and prey of salmon.

The warmer, drier weather in the Pacific Northwest often associated with El Niño can also cause or increase the severity of regional droughts. Droughts reduce streamflows through the Columbia and Snake River migratory corridor, increase water temperatures, and reduce the extent of suitable habitat in some drainages. Each of these physical effects has been shown to reduce salmon survival. Thus, El Niño events are associated with poor returns of salmon and steelhead.

Unseasonably cool south Pacific sea surface temperatures, typically associated with a positive SOI, tend to have quite different effects in the north Pacific and the Columbia basin. Termed La Niña, positive SOIs tend to be associated with cooler north Pacific surface water temperatures, and cooler, wetter fall and winter conditions inland. Conditions associated with La Niña tend to increase snowpack and runoff in the Interior Columbia basin, improving outmigration conditions through the lower Columbia River, and ocean conditions tend to be more conducive for coastal upwelling early in the spring, providing better feeding conditions for young salmon.

Currently, NOAA Physical Sciences Division calculates a "Multivariate El Niño Southern Oscillation Index" or MEI, which effectively inverts the SOI relationships: a positive MEI indicates El Niño conditions and a negative MEI a La Niña. Once established, El Niño and La Niña conditions tend to persist for a few months to two years although El Niño conditions have dominated the Pacific since 1977 and persisted from 1990 through 1995 (Figure 4.1-4 below). It is likely that the dominance of El Niño conditions since the late 1970s has contributed to the depressed status of many stocks of anadromous fish in the PNW.

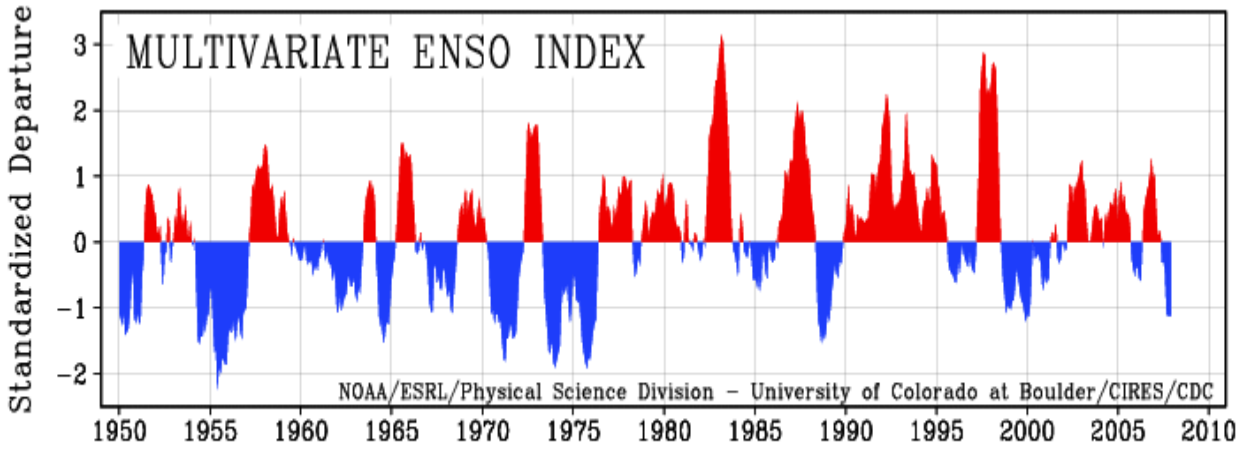

Figure 4.1-4 Time-series of MEI conditions from 1950 through November 2007. Source: NOAA 2008

4.1.2.2 Pacific Decadal Oscillation

First defined by Steven Hare in 1996, the Pacific Decadal Oscillation (PDO) index is the leading principal component (a statistical term) of variability in North Pacific sea surface temperatures (poleward of 20° N for the 1900-1993 period; JISAO 2008).

Major changes in northeast Pacific marine ecosystems have been correlated with phase changes in the PDO; warm eras have seen enhanced coastal ocean biological productivity in Alaska and inhibited productivity off the west coast of the contiguous United States, while cool PDO eras have seen the opposite north-south pattern of marine ecosystem productivity (e.g., Hare et al. 1999). Thus, smolt-to-adult return ratios for Columbia basin salmon tend to be high when the PDO is in a cool phase and low when the PDO is in a warm phase.

Two main characteristics distinguish the PDO from El Niño: first, 20th century PDO "events" persisted for 20-to-30 years, while typical El Niño events persisted for 6 to 18 months; second, the climatic fingerprints of the PDO are most visible in the North Pacific/North American sector, while secondary signatures exist in the tropics – the opposite is true for El Niño. Several independent studies find evidence for just two full PDO cycles in the past century: "cool" PDO regimes prevailed from 1890-1924 and again from 1947-1976, while "warm" PDO regimes dominated from 1925-1946 and from 1977 through (at least) the mid-1990s (Figure 4.1-5). Minobe (1997) has shown that 20th century PDO fluctuations were most energetic in two general periods, one from 15 to 25 years, and the other from 50 to 70 years.

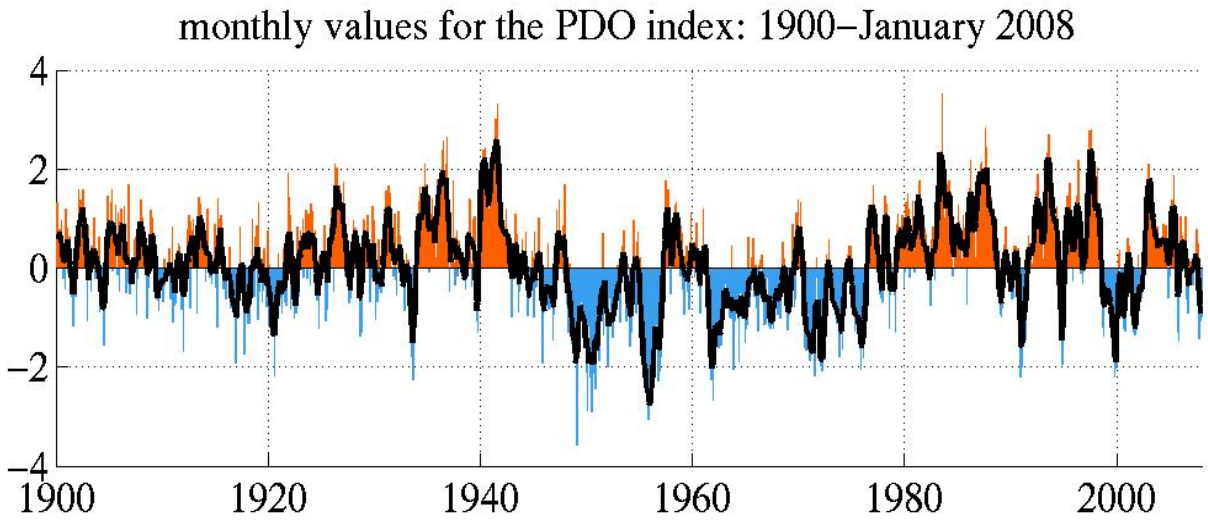

Figure 4.1-5 Monthly Values for the PDO Index: 1900-January 2008

Mantua and Hare (2002) state, “The physical mechanisms behind the PDO are not currently known.” Likewise, the potential for predicting this climate oscillation is not known. Some climate simulation models produce PDO-like oscillations, although often for different reasons. Discovery of mechanisms giving rise to the PDO will determine whether skillful decades-long PDO climate predictions are possible. For example, if a PDO arises from air-sea interactions that require 10 year ocean adjustment times, then aspects of the phenomenon could, theoretically, be predictable at lead times of up to 10 years. Even in the absence of a theoretical understanding, PDO climate information improves season-to-season and year-to-year climate forecasts for North America because of its strong tendency for multi-season and multi-year persistence. From the perspective of societal impact, recognition of PDO is important because it shows that "normal" climate conditions can vary over time scales (decades) used to describe the length of a human's lifetime.

Recent evidence suggests that marine survival of salmonids fluctuates in response to the PDO's 20 to 30 year cycles of climatic conditions and ocean productivity (Cramer et al. 1999). Ocean conditions that affect the productivity of Northwest salmonid populations appear to have been in a low phase of the cycle for some time and to have been an important contributor to the decline of many stocks. The survival and recovery of these species will depend on their ability to persist through periods of unfavorable hydrologic and oceanographic conditions.

4.1.2.3 Global Climate Change

Ongoing global climate change has implications for the current and likely future status of anadromous fish in the Pacific Northwest. Recent studies, particularly by the Independent Scientific Advisory Board (ISAB 2007), describe the potential impacts of climate change in the Columbia River Basin. These effects, according to the ISAB, may alter precipitation and temperature levels in the basin and, in particular, impact the operation of the Willamette Project and the Federal Columbia River Power System and habitat used by rearing and migrating life-stages of salmon and steelhead. In the Columbia Basin, which relies on cooler winter temperatures to store a spring/summer water supply in the snowpack, alterations to precipitation and temperature levels may have the following physical impacts:

- Warmer air temperatures will result in a shift to more winter/spring rain and runoff, rather than snow that is stored until the spring/summer melt season.
- With a shift to more rain and less snow, the snowpacks will diminish in those areas that typically accumulate and store water until the spring freshet.
- With a smaller snowpack, these watersheds will see their runoff diminished and exhausted earlier in the season, resulting in lower streamflows in the June through September period.
- River flows in general and peak river flows are likely to increase during the winter due to more precipitation falling as rain rather than snow.
- Water temperatures will continue to rise, especially during the summer months when lower streamflow and warmer air temperatures will contribute to the warming regional waters.

Such responses to warming air temperatures and changing precipitation will not be spatially homogeneous across the entire Columbia River Basin. Following anticipated air temperature increases, the distribution and duration of snowpack in those portions of the basin at elevations high enough to maintain temperatures well below freezing for most of the winter and early spring would be less affected. Low-lying areas in the Interior, which historically have received scant precipitation, have contributed little to total streamflow. This condition would also be relatively unaffected. The most noticeable changes will occur in the "transient snow" watersheds such as the Willamette Basin where the threshold between freezing and non-freezing temperatures is much more sensitive to warming. Not only would changes in the distribution of precipitation between rain and snow affect the shape of the annual hydrograph and water temperature regimes, but more frequent and more severe rain-on-snow events could affect flood frequency with implications for scouring out incubating and young-of-the-year-fish (ISAB 2007).

The ISAB report also anticipates that large-scale ecological changes will occur over a 35-year time period. For example, the frequency and magnitude of insect infestations of forested lands

and the frequency and intensity of forest fires are likely to become larger during this time period as well. As reported by the ISAB (2007), "fire frequency and intensity have already increased in the past 50 years, and especially the past 15 years, in the shrub steppe and forested regions of the West. Drought and hot, dry weather already have led to an increase in outbreaks of insects in the Columbia Basin, especially mountain pine beetle, and insect outbreaks are likely to become more common and widespread."[1] Such landscape changes have implications for salmon habitat and survival.

The ISAB (2007) identified the following list of likely effects of projected climate changes on Columbia basin salmon:

- Anticipated water temperature increases, and the subsequent depletion of cold water habitat, could reduce the areal extent of suitable inland salmon habitats. ISAB (2007) assessed the potential impacts of climate warming on Pacific Northwest salmon habitat. Locations that were likely to experience an average weekly maximum temperature that exceeded the upper thermal tolerance limit for a species were considered to be lost habitat. Projected salmon habitat loss would be most severe in Oregon and Idaho with potential losses exceeding 40% of current by 2090. Loss of salmon habitat in Washington would be a less severe case of about 22% loss by 2090. O'Neal's approach assumed a high rate of greenhouse gas emissions and used a climate model that projected a 5 degree C in global temperatures by 2090, a value that is higher than the scenarios considered most likely (ISAB 2007). This conservative estimate of potential habitat loss does not consider the associated impact of changing hydrology.
- Variations in intensity of precipitation may alter the seasonal hydrograph. With reduced snowpack and greater rainfall, the timing of stream flow will likely shift, depreciably reducing spring and summer stream flow, and increasing peak river flows (ISAB 2007). This reduction in stream flow may impact the quality and quantity of tributary rearing habitat, greatly affecting spring and summer salmon and steelhead runs. In addition, the Pacific Northwest's low late-summer and early-fall stream flows are likely to be further reduced. Reduced late-summer and early-fall flows, in conjunction with rising water temperatures, are likely to adversely impact juvenile fall Chinook and chum salmon by depleting essential summer shallow mainstem rearing habitat.
- Considering both the water temperature and hydrologic effects of climate change, Crozier et al. (2008) showed that the abundance of four studied Snake River spring/summer Chinook populations would be substantially decreased (20-50% decline from simulated average abundance based on historical 1915-2002 climate) and extinction risks substantially increased by long-term exposure to climate conditions likely to exist in 2040. Hydrologic and physical changes in the Pacific Northwest environment have implications for the habitat, populations, and spatial distributions of Pacific salmonids (Zabel et al. 2006).
- Eggs of fall and winter spawning fish, including Chinook, coho, chum, and sockeye salmon, may suffer higher levels of mortality when exposed to increased flood flows. Higher winter water temperatures also could accelerate embryo development and cause premature emergence of fry.

[1] Removal of trees from riparian areas by fire or insects will lead, at least temporarily, to an increase in solar radiation reaching the water and exacerbate the water temperature. The potential for climate-induced fire and insect outbreaks has the potential to disproportionately impact habitats of key importance to native fish and wildlife populations (ISAB 2007).

- Increases in seasonal mainstem Snake and Columbia River water temperature would accelerate the rate of egg development of fall Chinook that spawn in the mainstem of the Snake and Columbia rivers, and lead to earlier emergence at a smaller average size than historically. Also, dam and reservoir passage survival is affected by water temperatures with the lowest rates of survival typically occurring when water temperatures are warmest. Potential impacts of increased water temperatures on adult salmon include delay in dam passage, failure to enter fish ladders, increased fallback, and loss of energy reserves due to increased metabolic demand. Increases in mortality also may be caused by fish pathogens and parasites as these organisms often do not become injurious until their host becomes thermally stressed.
- Earlier snowmelt and earlier, higher spring flows, warmer temperatures, and a greater proportion of precipitation falling as rain rather than snow, may cause spring Chinook and steelhead yearlings to smolt and emigrate to the estuary and ocean earlier in the spring. The early emigration coupled with a projected delay in the onset of coastal upwelling could cause these fish to enter the ocean before foraging conditions are optimal. The first few weeks in the ocean are thought to be critical to the survival of salmon off Oregon and Washington, so a growing mismatch between smolt migrations and coastal upwelling would likely have significant negative impacts on early ocean survival rates.
- Within the Columbia estuary, increased sea levels in conjunction with higher winter river flows could cause the degradation of estuary habitats created by increasing wave damage during storms. Numerous warm-adapted fish species, including several non-indigenous species, normally found in freshwater have been reported from the estuary and might expand their populations with the warmer water and seasonal expansion of freshwater habitats. Climate change also may affect the trophic dynamics of the estuary due to upstream extension of the salt wedge in spring-early summer caused by reduced river flows. The landward head of the salt wedge is characterized by a turbulent region known as the estuary turbidity maximum, an area with high concentrations of fish food organisms such as harpacticoid copepods. Changes in the upstream extension of the salt wedge will influence the location of this zone, but it is difficult to forecast the effect this change will have on juvenile salmon.
- Scientific evidence strongly suggests that global climate change is already altering marine ecosystems from the tropics to polar seas. Physical changes associated with warming include increases in ocean temperature, increased stratification of the water column, and changes in the intensity and timing of coastal upwelling. These changes will alter primary and secondary productivity, the structure of marine communities, and, in turn, the growth, productivity, survival, and migrations of salmonids.
- Changing ocean temperatures may alter salmon behavior, distribution, and migrations, increasing the distance to migrations from their home streams to ocean feeding areas. Energetic demands are increased at warmer temperatures, requiring increased consumption of prey to maintain a given growth rate. This could lead to intensified competition among species, as well as an increased reduction in growth rates, further exacerbating the prey/predator relationship. In addition, food availability in the ocean may be altered by climate change. Increasing concentration of CO_2 in the oceans lowers pH, which reduces the availability of carbonate for shell-forming marine animals. Pteropods are expected to be negatively affected, and they can comprise up to 40% or more of the diet of some salmon species, although another suitable prey item might replace them in the ecosystem. If salmon migrate farther to the north and/or food is less available, longer times may

be required to reach maturity, delaying the usual times of adult migrations into coastal water and rivers.

- Global climate change in the Pacific Northwest may be similar to those experienced during past periods of strong El Niños and warm phases of the PDO.

EPA (2008) presents a series of environmental indicators to measure current status and trends of the U.S. environment. Among the indicators presented is a nationwide evaluation of streamflow changes through time. This indicator shows that while both high flows and low flows have varied over the past 50 years, no long-term trend in either parameter was established. However, the national trend is toward a reduced annual variability in streamflow, likely a result of increased streamflow regulation (i.e. dams), not climate change.

An extensive hydrologic trend analysis was conducted for the Willamette River (Gregory et al. 2007). While substantial alteration of the natural hydrologic regime was identified by the analysis, the identified effects are attributable to the operation of Willamette Project dams, particularly operations designed to prevent flooding.

Given the broad natural variability in streamflow, the strength of short-term climate fluctuations and their effects on streamflow (e.g. El Nino), and the highly developed nature of the Willamette watershed, it will likely be difficult to identify climate-driven trends in Willamette basin streamflows from analysis of measured flow time-series until such effects are quite strong.

The effects of climate change are considered qualitatively in this Opinion. In addition, NMFS explicitly considers actions which are consistent with the ISAB's mitigation recommendations (see ISAB recommendations in Chapter 5.1 for further detail). However, the time frame, and the scope of climate change is not clear. Many climate change predictions describe changes up to 100 years. For the 15-year term of this Opinion, NMFS uses conservative assumptions and sets the stage for mitigation actions should they become necessary.

4.1.3 Water Diversions

Surface water is removed from the rivers and streams of the Willamette Basin for a multitude of municipal, industrial, and agricultural purposes. Most water diversions are relatively small, but cumulatively they have an impact, especially in localized situations, such as in tributaries with lower flows, or in water-deficit years. Water diversions present hazards for fish. Fish can be inadvertently intercepted and entrained into water flowing to municipal, industrial and agricultural uses, leading to their death. Some diversions are associated with small dams that can pose barriers to migration. The water removed from the stream reduces flow and water depth, reducing its quality as fish habitat. Most of the water diversions are small pumps, but some are gravity diversions.

Some surface water diversions in the Willamette Basin have had adequate fish protective measures installed, such as appropriate screens, but many have not and there is no current or pending requirement mandating fish protective measures to be installed at existing diversions. Most older diversions are not required under current State and Federal law to install and operate fish protective

measures such as screens and thus are likely to continue to operate indefinitely without adequate fish protective measures.

Reclamation contracts to sell stored water impounded by the Willamette Project's USACE dams, thus providing a regulatory nexus to require fish protective measures for those diversions associated with these federal water contracts. However, these represent a small subset of all the diversions in the basin, and of the overall hazards presented by diversions within the Willamette Basin.

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Section 4.2
Middle Fork Willamette Baseline

4.2.2 Current Status of Anadromous Salmonids within the Middle Fork Willamette Subbasin

4.2.2.1 UWR Chinook Salmon

Population Viability

The Middle Fork population of UWR Chinook salmon is considered to be at very high risk of extinction, based on an analysis of its recent abundance, productivity, spatial structure, and diversity (McElhany et al. 2007). Chronically unfavorable conditions for the population within a dramatically reduced geographic range create most of this risk, but the potential for catastrophic events such as landslides and disease epidemics, is also a contributor (WLCTRT 2003).

Abundance & Productivity

The Middle Fork Willamette Chinook population's limited natural abundance and productivity pose a very high extinction risk (McElhany et al. 2007), an issue of particular concern given that it is a core population identified as critical to the long-term persistence of the ESU (see section 3.2.1.3 in Chapter 3, Rangewide Status). Abundances of wild spawners are low, pre-spawn mortality rates for these fish are high, and recent use of natural spawning areas has been dominated by fish of hatchery origin (Schroeder et al. 2006).

Adult UWR Chinook returning to the Middle Fork subbasin are counted at Dexter Dam, the upper limit of habitat that is now naturally accessible in the mainstem Middle Fork Willamette River, and at Fall Creek Dam as the USACE passes them into the watershed upstream. Counts of redds and spawned-out fish are conducted along the lower mainstem and on Fall Creek above the dam. Natural spawning apparently did not occur in the mainstem below Dexter before the dam was built (Lindsay et al. 1999). This indicates that the habitat below Dexter is not as high quality as that above the dams.

Numbers of adult UWR Chinook that have been counted at Dexter and Fall Creek dams during the years following dam completion are given in Figure 4.2-3. Annual counts at Dexter have varied from a low of 802 in 1960 to a high of nearly 18,000 in 1990, and have exceeded 5,500 adults since 2000. Wild fish are thought to have comprised a very small fraction of the Dexter counts except for the single generation of salmon whose adults were actually blocked from returning to their natal habitats. Annual returns to Fall Creek Dam averaged approximately 300 fish in the 1980s and about 150 fish during the 1990s, before exhibiting a recent upswing that apparently reflects improved ocean conditions and an expanded hatchery supplementation effort. The adult counts at Fall Creek Dam have for decades have been a mixture of naturally produced fish whose parents spawned above the dam combined with fish that were out-planted as juveniles into or below Fall Creek Reservoir in an effort to maintain natural production despite poor passage conditions at the dam.

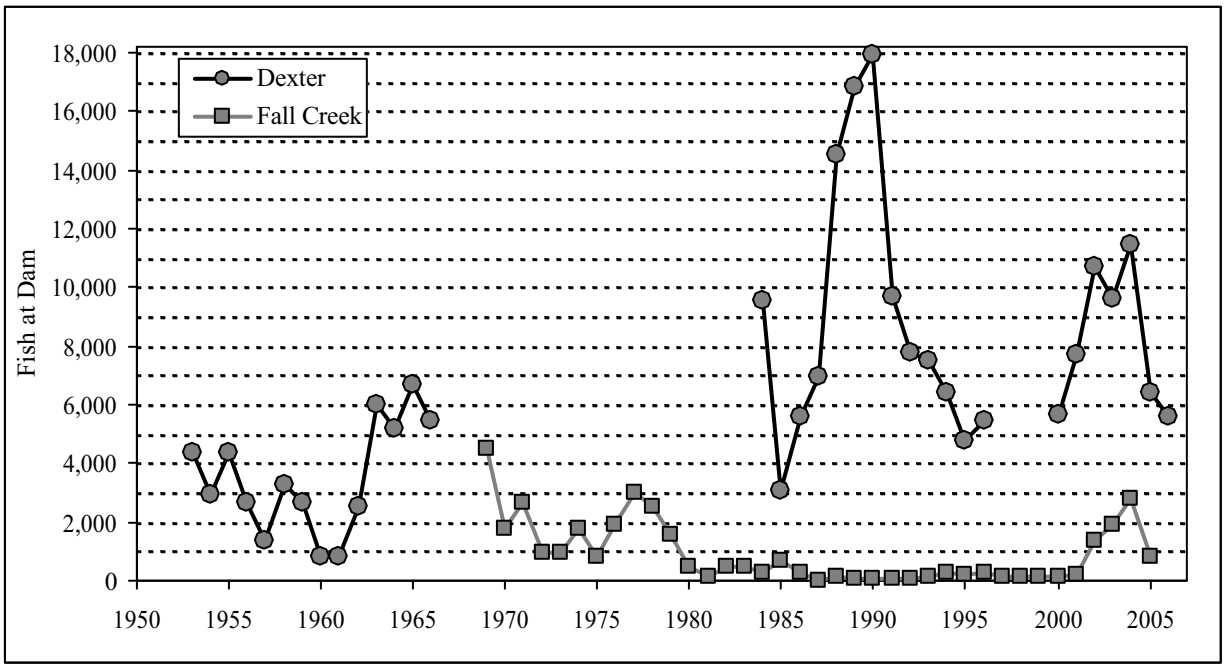

Figure 4.2-3 Hatchery-influenced counts of adult UWR Chinook salmon at Dexter and Fall Creek dams during the post-dam period (Streamnet trends 50886, 59338; Schroeder et al. 2006; McLaughlin et al. 2008)

Improvements to fish marking and monitoring efforts within the Willamette Basin now allow a high level of confidence in distinguishing hatchery-origin from wild (natural-origin) UWR Chinook. Under contract to the USACE, ODFW has since 2002 conducted intensive monitoring of hatchery and wild Chinook returning to Dexter Dam and to spawning areas in the lower Middle Fork, and in Fall Creek above Fall Creek Dam (Schroeder et al. 2006; McLaughlin et al. 2008). Monitoring results from 2002 through 2005 showed that returns of wild adults to the lower Middle Fork were very low, with an annual average of fewer than 50 captured at Dexter, and what appear to have been even lower numbers of wild spawners present in mainstem spawning areas between the town of Jasper[1] and Dexter Dam (Schroeder et al. 2006; McLaughlin et al. 2008). Hatchery fish accounted for 82-95% of the spawners in the lower river during the 2002-2005 period, and annual pre-spawn mortality rates averaged 92% (Schroeder et al. 2006; McLaughlin et al. 2008). This situation makes it unlikely that the lower river has sustained a "wild" population.

Recent monitoring by ODFW on upper Fall Creek indicates that it is more successfully used as a Chinook spawning area than is the mainstem Middle Fork, but the potential for the run of UWR Chinook in this stream to become self-sustaining without major passage improvements appears low. Although densities of Chinook redds (nests) have been substantially higher in Fall Creek above the reservoir than in the Middle Fork (Figure 4.2-4), the proportions of hatchery-origin spawners in the stream have been quite high (74-100%) (McLaughlin et al. 2008). Rates of pre-spawn mortality for adult UWR Chinook above Fall Creek Reservoir averaged 44-58% during the 2002-2005 period (Schroeder et al. 2006).

[1] 7 miles below Dexter Dam, RM 195.

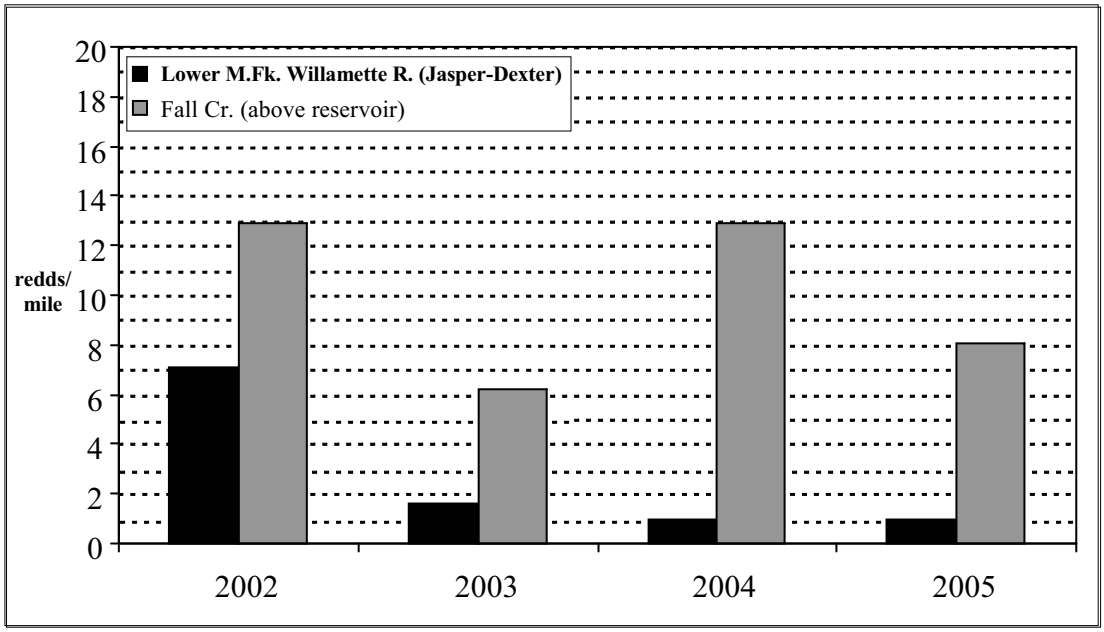

Figure 4.2-4 Spring Chinook redds (nests) per mile surveyed along the lower Middle Fork Willamette River and in Fall Creek above Fall Creek Reservoir, 2002-2005 (Schroeder et al. 2006).

Spatial Structure

The majority of the historical spawning areas of Middle Fork Willamette Spring Chinook have been blocked by dams, and the remaining naturally accessible habitats do not appear to provide the full suite of conditions needed to sustain a natural salmon population. This situation poses a high to very high risk of extinction to the persistence of what little remains of the subbasin's natural population of UWR Chinook (McElhany et al. 2007).

Diversity

The lack of diversity of the Middle Fork Willamette population of spring Chinook reflects a high risk of extinction, based on an examination of life history traits, effective population size, hatchery impacts, anthropogenic mortality, and habitat diversity. Their greatest concern was the large proportion of hatchery-origin fish in natural spawning areas (McElhany et al. 2007).

4.2.2.1.1 Limiting Factors & Threats to Recovery for UWR Chinook salmon

The limiting factors and threats currently inhibiting the survival and recovery of UWR Chinook salmon in the Middle Fork Willamette watershed, as identified in the Draft Willamette Salmon and Steelhead Recovery Plan (ODFW 2007b), are shown in Table 4.2-1. Primary causes for the severely limited natural production of this species in the Middle Fork subbasin include blockage from critical habitat by Willamette Project dams, high pre-spawning mortality of adults, and altered water temperatures during egg incubation in the remaining habitat below the dams. Even though the limiting factors and threats are broken into two groups, key and secondary, the secondary factors are important to address as well as the key factors.

Table 4.2-1 Summary of key and secondary limiting factors and threats for Chinook in the Middle Fork Willamette watershed (ODFW 2007b). The entire life cycle limiting factors and threats assessment is found in section 4.1.

Threats	Species	Tributaries (Streams and Rivers within Population Area)							
		Egg	Alevin	Fry	Summer Parr	Winter Parr	Smolt	Adult	Spawner
Harvest	Chinook								
Hatchery	Chinook								3
Hydropower/ Flood Control	Chinook	9f 7g		10d			1f	2e 2m	7f
Landuse	Chinook			8a	8a 9a	8a			
Introduced Species	Chinook								

Black cells indicated key concerns; Gray cells indicated secondary concerns.

Key threats and limiting factors

1f Mortality at Middle Fork Willamette hydropower/flood control dams. This mortality is due to direct mortality in the turbines and/or smolts being trapped in the reservoirs.

2e Impaired access to habitat above Middle Fork Willamette hydropower/flood control dams.

2m Pre-spawning mortality due to crowding and high water temperatures below Middle Fork Willamette hydropower/flood control dams.

3 Hatchery fish interbreeding with wild fish resulting in a risk of genetic introgression.

7f Lack of gravel recruitment below Middle Fork Willamette hydropower/flood control dams due to gravel capture in upstream reservoirs.

8a Impaired physical habitat from past and/or present land use practices (tributaries).

9f Elevated water temperatures below Middle Fork Willamette hydropower/flood control dams resulting in premature hatching and emergence.

10d Reduced peak flows leading to decreased channel complexity and diversity of fish habitat by reducing channel movement that is important for recruitment of gravel and large wood, and maintaining varying seral stages of riparian vegetation. Lower peak flows also reduces scour and formation of pools.

Secondary threats and limiting factors

7g Streambed coarsening below Middle Fork Willamette hydropower/flood control dams due to reduced peak flows.

8a Impaired physical habitat from past and/or present land use practices (presmolts, Westside tributaries).

9a Elevated water temperatures from past and/or present land use practices resulting in decreased survival and/or growth.

4.3.1 Historical Populations of Anadromous Salmonids in the McKenzie Subbasin

4.3.1.1 UWR Chinook Salmon

Historical spawning areas for UWR Chinook within the McKenzie subbasin included the mainstem McKenzie River, Smith River, Lost Creek, Horse Creek, the South Fork, Blue River, Gate Creek, and Mohawk River (Mattson 1948, Parkhurst et al. 1950). Habitat that remained suitable for, and available to, these fish in the 1940s was estimated to have the capacity to support about 80,000 spawners (Parkhurst et al. 1950). However, adult runs this large were never documented. The Oregon Fish Commission estimated that the largest run of UWR Chinook salmon into the McKenzie River subbasin for which it had data was one of about 46,000 adults in 1941. This estimate was based on an assumption that 39 percent of the UWR Chinook salmon adults counted passing over Willamette Falls were bound for the McKenzie subbasin (Mattson 1948, USACE 1995). Estimated run sizes of UWR Chinook returning to the McKenzie subbasin from 1945-1960 averaged 18,000 adults (USACE 1995). A run of 4,300 adult Chinook escaped to spawn in the South Fork alone in 1958 (USFWS 1959).

4.3.1.2 UWR Steelhead

UWR steelhead are sometimes found within lower elevation areas of the McKenzie subbasin, but these areas are not thought to have supported a historical population of the species.

4.3.2 Current Status of ESA-Listed Anadromous Salmonids within the Subbasin

4.3.2.1 UWR Chinook Salmon

Population Viability

The latest status assessment of UWR Chinook salmon, by McElhany et al. (2007), rated the McKenzie population as being at moderate risk of extinction based on an evaluation of its abundance, productivity, spatial structure, and diversity. Within-subbasin contributors to this risk include habitat degradation associated with USACE dams, land use, and the ecological and genetic effects of a very large fish hatchery program within the subbasin. Potentially catastrophic events that could unfavorably affect the population include landslides, hatchery-related disease epidemics, and pollution discharges from roadway/transportation spills (WLCTRT 2003).

Abundance & Productivity (A&P)

McElhany et al. (2007) classified the UWR Chinook population in the McKenzie subbasin as facing a moderate extinction risk based on its abundance and productivity, with a modest level of uncertainty. The population was once one of, if not the largest within the Willamette Basin, but now has greatly reduced numbers of spawning adults. McElhany et al. (2007) estimated the spawning population's long-term (1970-2005) geometric mean abundance as 1,655 natural-origin spawners, its short-term (1990-2005) geometric mean abundance as 2,104.

Adult UWR Chinook returning to the McKenzie River are counted as they pass over Leaburg Dam and surveys are conducted in the natural spawning areas of these fish both above and below this dam. Figure 4.3-2 gives the numbers of wild (natural-origin) and all (wild plus hatchery-origin) adult Chinook estimated to have passed Leaburg Dam each year from 1970 through 2006. Estimates of the wild component of the run were relatively uncertain until 2001, when expanded hatchery fish marking and monitoring programs enabled accurate discrimination of wild fish. Annual numbers of wild adult Chinook passing Leaburg Dam during the most recent 5-year period for which data are available (2002-2006) ranged from a high of 4,899 fish in 2003 to a low of 2,189 fish in 2006, and averaged 3,509 fish (McLaughlin et al. 2008). The number of wild adults passing the dam in 2003 was similar in magnitude to the largest estimates of wild fish escapement over the dam since 1970.

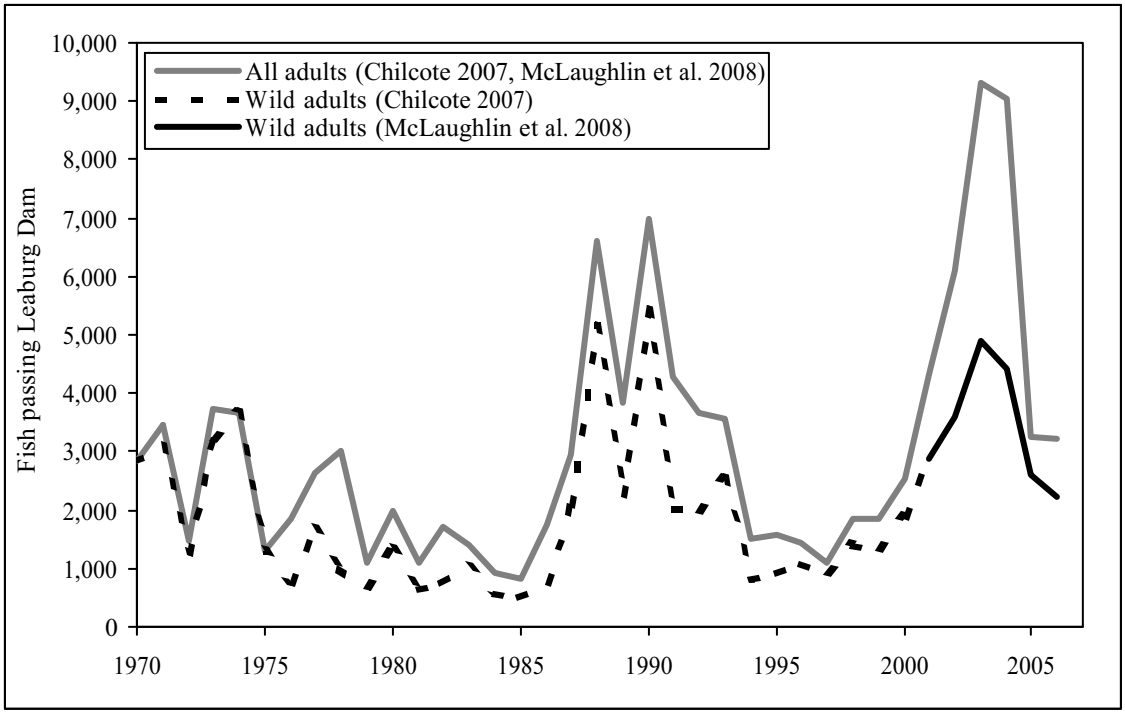

Figure 4.3-2 Estimated annual number of wild and all (wild and hatchery-origin) adult spring Chinook salmon passing above Leaburg Dam on the McKenzie River, Oregon, 1970-2006. Data sources: Chilcote (2007) and McLaughlin et al. (2008).

Hatchery-origin fish continue to pass Leaburg Dam and enter the natural spawning areas of McKenzie spring Chinook above the dam, posing a potential risk to the productivity of the naturally spawning population (Table 4.3-1). McLaughlin et al. (2008) have, for Chinook runs since 2001, developed two sets of estimates of the annual percentage of adults passing above the dam that were of hatchery-origin. One set is based on straight dam counts and the other has an adjustment for what is thought to be fall-back (false passage) of hatchery-origin fish. Dam counts unadjusted for fall-back suggest that the annual percentages of hatchery-origin adults upstream of Leaburg Dam have ranged from 21% to 51%, and averaged 38% during the last 5 years (McLaughlin et al. 2008). The adjusted counts suggest lower percentages of hatchery fish above the dam, ranging from 17% to 39%, and averaging 30% during the last 5 years, and are

thought to provide a better indication of the proportion of hatchery fish in the naturally spawning population (McLaughlin et al. 2008).

Table 4.3-1 Estimated number of adult spring Chinook salmon of natural (wild) and hatchery origin passing upstream of Leaburg Dam, 2001-2005, as determined by analyses of otoliths in non fin-clipped fish and coded wire tags in fin-clipped fish (McLaughlin et al. 2008).

Year	Wild adults (natural-origin)	Adults of hatchery origin	Total	Percent hatchery-origin adults*
2001	2,880	1,422	4,302	33 (32)
2002	3,602	2,485	6,087	41 (35)
2003	4,899	4,428	9,327	47 (39)
2004	4,419	4,615	9,034	51 (39)
2005	2,435	659	3,094	21 (18)
2006	2,189	981	3,170	31(17)
5-year average (2002-2006)	3,509	2,634	6,143	38 (30)

* Percent hatchery values given in parentheses are intended to provide an adjustment for what appears to be dam fall-back of non-clipped fish.

The distribution of hatchery-origin Chinook spawners among natural spawning areas within the McKenzie subbasin is far from uniform and suggests that certain components of the population may be somewhat less affected by whatever influence stray hatchery spawners have on the productivity of wild fish. During 2001-2004, Schroeder et al. (2005) found lower proportions of hatchery-origin spawners in carcasses recovered in the mainstem upstream of a point near the South Fork confluence (Forest Glen) and in Lost and Horse creeks than were found in the South Fork or areas downstream. Hatchery spawners constituted a particularly high fraction of spawners in the lower McKenzie below Leaburg Dam (Schroeder et al. 2005).

Carcass recoveries from Chinook spawning areas suggest that rates of pre-spawn mortality above Leaburg Dam are relatively low compared to those seen for UWR Chinook in other spawning areas within the Willamette Basin. From 2001 through 2006, carcass recoveries above the dam suggest annual pre-spawn mortality rates ranging from 1% to 16%, and averaging 9%.

Spatial Structure

McElhany et al. (2007) rate the spatial structure of McKenzie spring Chinook salmon as characteristic of a population having a low to moderate risk of extinction. ODFW (2005b) estimates that 16% of the population's historical habitat has been blocked by dams. Cougar Dam now blocks access to most of the productive South Fork watershed, and Blue River Dam and the Carmen-Smith hydroelectric project block smaller amounts of habitat. High quality habitats remain accessible in significant portions of the subbasin not blocked by dams, but habitat degradation apparently extirpated a spawning aggregate in the Mohawk watershed a century ago (Parkhurst et al. 1950) and historically-significant rearing habitat in the upper Willamette River mainstem has been lost or damaged.

Diversity
McElhany et al. (2007) rated the diversity of the McKenzie population of UWR Chinook as reflecting a moderately high risk of extinction, based on an examination of available information on life history traits, effective population size, hatchery impacts, anthropogenic mortality, and habitat diversity. Key concerns in this regard were the genetic influences of the large hatchery program in the basin and the effects of altered thermal regimes below the USACE dams on fish life-histories.

4.3.2.2 UWR Steelhead

UWR Steelhead are sometimes found within lower elevation areas of the McKenzie subbasin, but these areas are not thought to have supported a historical population of the species.

4.3.2.3 Limiting Factors & Threats to Recovery

Factors within the McKenzie subbasin that are unfavorably affecting the status of its population of UWR Chinook have been summarized by ODFW (2007b) and are given in Table 4.3-2. Key limiting factors and threats to the species within the subbasin include a variety of dam effects, a large hatchery program developed partly to help offset dam effects, and the cumulative effects of multiple land and water use practices on aquatic habitat. Dams that lack effective passage facilities prevent wild fish from using historically important habitats on Federal lands in upper portions of the McKenzie subbasin, particularly above Cougar Dam on the South Fork McKenzie River. Habitat changes along the mainstem Willamette River and in the Columbia River estuary some related to the Willamette Project dams or to other USACE programs, also limit the populations.

In all, 2 of 4 primary limitations and 2 of 6 secondary limitations on the recovery of the McKenzie's ESA-listed population of UWR Chinook are related to USACE dams or programs (ODFW 2007b, Table 4.3-2). Even though the limiting factors and threats are broken into two groups, the secondary factors are important to address as well as the key factors.

Table 4.3-2 Key and secondary within-subbasin limiting factors and threats to recovery of McKenzie Spring Chinook (source: ODFW 2007b).

Threats	Species	McKenzie Subbasin (Streams and Rivers within Population Area)							
		Egg	Alevin	Fry	Summer Parr	Winter Parr	Smolt	Adult	Spawner
Harvest	Chinook								
Hatchery	Chinook			4b					3
				6c					
				6d					
Hydropower/ Flood Control	Chinook	9g		10d				2d	7e
Landuse	Chinook			8a	8a	8a			
					9a				
Introduced Species	Chinook								

Black cells indicate key concerns; Gray cells indicate secondary concerns.

Key threats and limiting factors

- 2d Impaired access to habitat above McKenzie hydropower/flood control dams.
- 3 Hatchery fish interbreeding with wild fish resulting in a risk of genetic introgression.
- 8a Impaired physical habitat from past and/or present land use practices.
- 10d Reduced peak flows leading to decreased channel complexity and diversity of fish habitat by reducing channel movement that is important for recruitment of gravel and large wood, and maintaining varying seral stages of riparian vegetation. Lower peak flows also reduces scour and formation of pools.

Secondary threats and limiting factors

- 4b Competition with naturally produced progeny of hatchery spring Chinook.
- 6c Predation by hatchery summer steelhead smolts.
- 6d Predation by hatchery rainbow.
- 7e Lack of gravel recruitment below McKenzie hydropower/flood control dams due to gravel capture in upstream reservoirs.
- 8a Impaired physical habitat from past and/or present land use practices.
- 9a Elevated water temperatures from past and/or present land use practices resulting in decreased survival and/or growth.
- 9g Elevated water temperatures below McKenzie hydropower/flood control dams resulting in premature hatching and emergence[1].

[1] Cougar water temperature control tower addressed temperature in South Fork McKenzie and most of the mainstem McKenzie River.

UWR Steelhead
UWR steelhead are also native to the South Santiam subbasin. These fish spawned historically in upper portions of the subbasin, above the sites of Foster and Green Peter dams, as well as in downstream tributaries (Olsen et al. 1992). No estimates of pre-1960s abundance are available for the subbasin's native winter steelhead. However, ineffective downstream passage at Foster and Green Peter Dams, and inadequate upstream passage at the latter facility are believed to have caused up to a 75% reduction in the native steelhead population in the upper subbasin over time (USACE 2000). After the dams were constructed, Buchanan et al. (1993) estimated that 2,600 winter steelhead spawned in the entire South Santiam River basin, including the upper mainstem above the dams and in Thomas, Crabtree, McDowell, Wiley, Canyon, Moose, and Soda Fork creeks.

4.5.2 Current Status of ESA-Listed Salmon and Steelhead within the Subbasin

4.5.2.1 UWR Chinook salmon

Population Viability
The South Santiam population of UWR Chinook is considered to be at very high risk of extinction, based on an analysis of its abundance, productivity, spatial structure, and diversity (McElhany et al. 2007). Chronically unfavorable conditions have influenced this risk, as does the potential for catastrophic events. WLCTRT (2003) rated the risks of catastrophic loss as high from landslides (based on geology and precipitation patterns), epidemics (due to hatchery releases), and pollution (related to roadway transportation spills).

Abundance & Productivity
In the draft viability assessment for South Santiam spring Chinook, McElhany et al. (2007) rated the population's limited abundance and productivity as posing a very high extinction risk. As described in this section, abundances of wild spawners are generally low, pre-spawn mortality rates for these fish are high, and recent use of natural spawning areas has been dominated by fish of hatchery origin (Schroeder et al. 2006).

Adult UWR Chinook returning to the South Santiam River are counted at a fish trap near the base of Foster Dam, and their redds are counted in spawning areas downriver as well as in a few tributaries. Figure 4.5-2 gives the numbers of adult fish counted in the Foster Trap each year from 1984 to 2005. During this period the returns have been strongly dominated by hatchery fish, peaked in 1990 at more than 7,000 fish, and peaked again in 2004 at more than 10,000. Returns were below average from 1992 to 1997, increased through 2004, and then decreased during 2005.

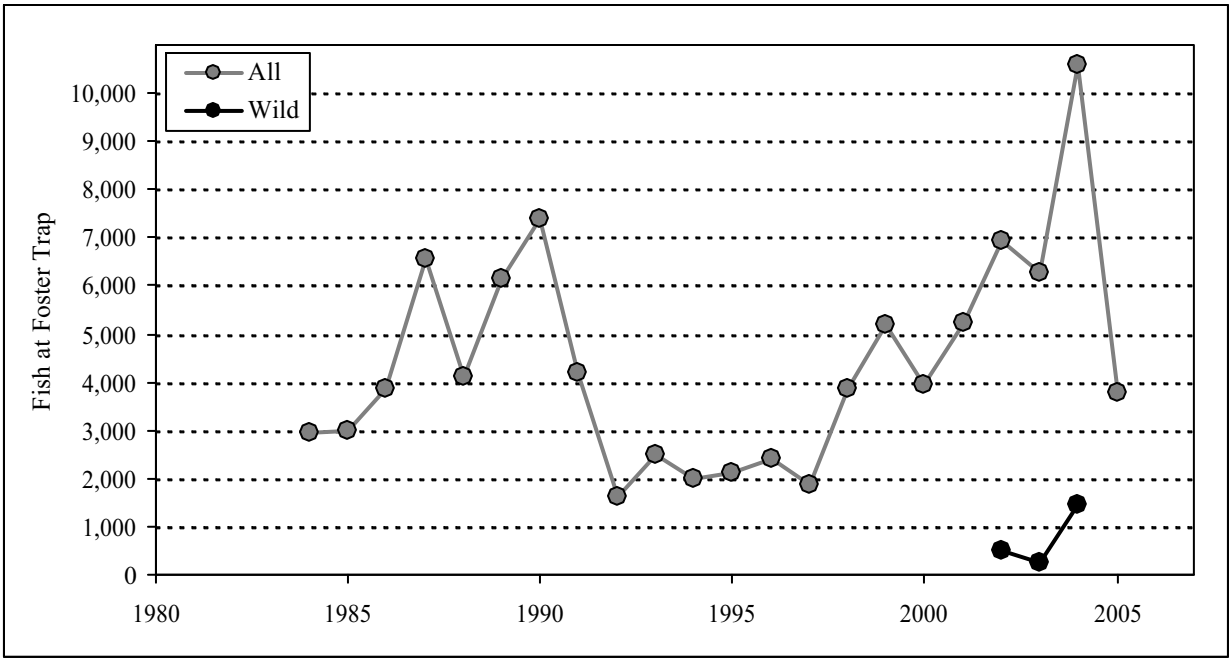

Figure 4.5-2 Annual returns of spring Chinook salmon to Foster Dam from 1984-2005 (Streamnet trend 58668), including 2002-2005 estimates of the wild component that were developed by McLaughlin et al. (2008).

Improvements to fish marking and monitoring efforts within the Willamette Basin now allow a high level of confidence in distinguishing hatchery-origin from wild (natural-origin) UWR Chinook. Under contract to the USACE, ODFW has since 2002 conducted intensive monitoring of hatchery and wild spring Chinook returning to Foster Dam and to mainstem spawning areas downstream in the lower South Santiam (Schroeder et al. 2006; McLaughlin et al. 2008). Monitoring results from 2002 through 2005 showed that returns of natural origin adults to the South Santiam River were much lower than those of hatchery fish, that hatchery fish dominated the trap catch at Foster Dam and in the spawning areas downstream, and that fewer wild Chinook were spawning successfully in the lower river (<300 fish per year) than returned to the Foster Trap (234-1457 fish per year). Hatchery fish accounted for 79-91% of the spawners in the river from Foster Dam down to Waterloo during this period, and annual pre-spawning mortality rates ranged from 26-72% (McLaughlin et al. 2008). This situation, extended over the long term, would make it improbable that the run of fish could include many natural origin individuals more than a few generations removed from the hatchery. Both natural and hatchery-origin Chinook that enter the Foster Trap are used as hatchery broodstock or are released to spawn in streams above and below Foster Dam, in the Molalla River system, or in the Calapooia River (Beidler and Knapp 2005).

Recent UWR Chinook use of spawning areas within the lower South Santiam subbasin has been intense in the river immediately below Foster Dam and considerably more sparse elsewhere (Figure 4.5-3). Use of all spawning areas that have been monitored within the subbasin has been dominated by the presence of hatchery-origin spawners to the detriment of wild fish (Schroeder et al. 2006).

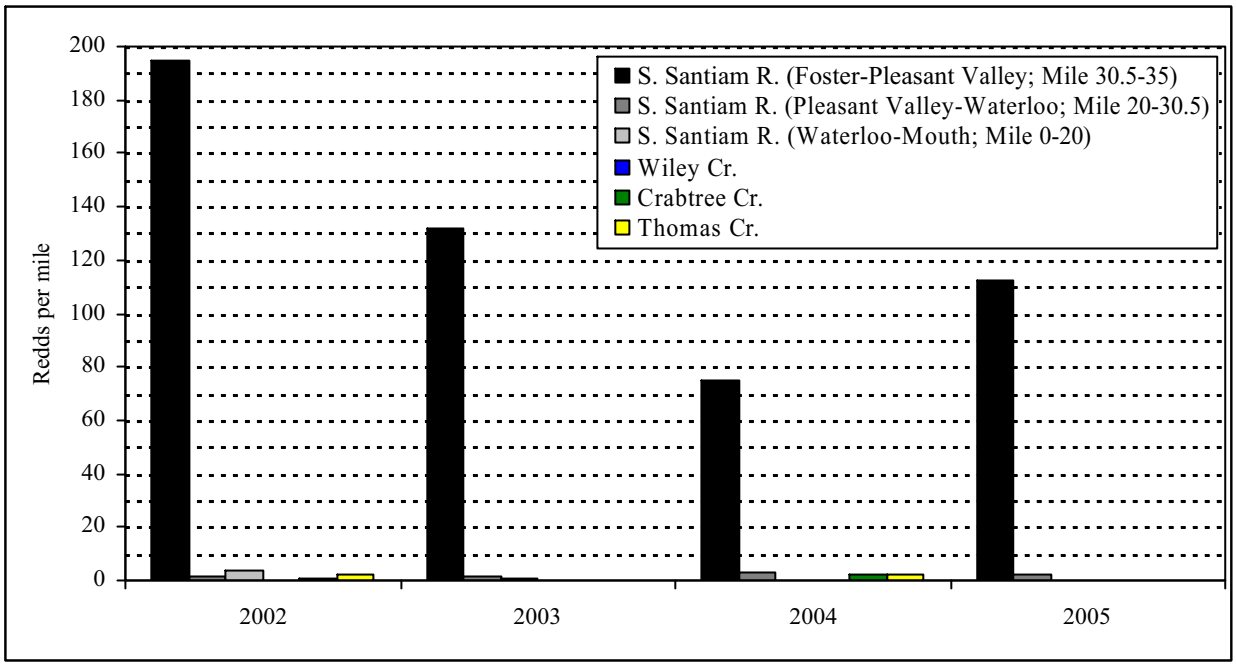

Figure 4.5-3 Spring Chinook redds (nests) per mile surveyed along the South Santiam River immediately below Foster Dam and in other spawning areas examined within the lower South Santiam subbasin, 2002-2005 (Schroeder et al. 2005; StreamNet trends 53769, 56766, 57171, 57173).

Spatial Structure

Reduced spatial structure caused by a lack of effective fish passage at USACE dams and by diminished habitat quality in areas not blocked by dams leads to a high risk of extinction for the South Santiam population of spring Chinook (McElhany et al. 2007). ODFW (2005b) estimates that 40% of the habitat historically suitable for spring Chinook in the South Santiam subbasin is now inaccessible, and McElhany et al. (2007) note that the inaccessible areas held some of the best habitat for the species. ODFW (2005b) estimates that 70% of the subbasin's spring Chinook population once spawned in areas that are inaccessible now.

Diversity

McElhany et al. (2007) rated the current diversity of the South Santiam population of spring Chinook as contributing to a high risk of extinction, based on evidence of life history traits, small effective population size, hatchery impacts, anthropogenic mortality, and reduced habitat diversity. Their greatest concern was the large proportion of hatchery-origin fish in natural spawning areas.

4.5.2.2 Winter Steelhead

Population Viability

The South Santiam population of UWR Steelhead is at low to moderate risk of extinction with considerable uncertainty, based on an analysis of its abundance, productivity, spatial distribution, and diversity (McElhany et al. 2007). The potential for catastrophic events contributes to this risk. WLCTRT 2003 reported the risk of catastrophic losses was high from landslides (based on

4.6.1 Historical Populations of Anadromous Salmonids in the Subbasin

The North Santiam subbasin is the natural home of an independent population of UWR Chinook and independent population of UWR steelhead. Historical information on these populations is given below.

UWR Chinook

The mainstem North Santiam River is free of natural barriers up to its headwaters, approximately 35 mainstem miles above Detroit Dam (WNF DRD 1995). Before the USACE dams were constructed, adult Chinook salmon spawned in the upper reaches of the North Santiam River and in headwater tributaries such as the Marion Creek, the Breitenbush River, and Blowout Creek (WNF DRD 1994, 1996, 1997), as well as in the mainstem below the dam sites and in Little North Santiam River (Parkhurst et al. 1950). Historical estimates of the abundance of these fish in the North Santiam subbasin range from 8,250 adults escaping to spawn upstream of Detroit Dam in 1934 (Wallis 1963) despite intense downstream fisheries, to 2,830 spawners throughout the entire subbasin in 1947 (Mattson 1948). Parkhurst et al. (1950) estimated that there was sufficient habitat in the North Santiam to accommodate at least 30,000 adults. Mattson (1948) estimated that 71% of the spring Chinook production in the North Santiam subbasin occurred in areas that have since been blocked by Detroit and Big Cliff Dams.

UWR Steelhead

Surveys conducted in 1940, before the dams were constructed, led to estimates of at least 2,000 steelhead spawning in the mainstem North Santiam, with additional runs to the Breitenbush River, Marion Fork, Pamelia and Blowout creeks, and the Little North Santiam (Parkhurst et al. 1950). The species also used many smaller streams in these and other tributary drainages (BLMS 1998; Olsen et al. 1992; WNF DRD 1994, 1995, 1996, 1997). After construction of the dams, Thompson et al. (1966) estimated that the entire North Santiam subbasin supported a population of 3,500 winter steelhead, including an unknown proportion of hatchery fish, in the 1950s and early 1960s, including adults trapped at Minto.

4.6.2 Current Status of Native Anadromous Salmonids within the Subbasin

4.6.2.1 UWR Chinook Salmon

Population Viability

The North Santiam population of UWR Chinook is considered to be at a high risk of extinction (with considerable certainty) based on an assessment of its abundance, productivity, spatial structure, and diversity (McElhany et al. 2000). Chronically unfavorable conditions within a reduced geographic distribution create much of this risk, but the potential for catastrophic events such as landslides, hatchery-related disease outbreaks, or volcanic events, is also a contributor.

Abundance & Productivity

The North Santiam Chinook population's limited abundance and productivity pose a very high risk of extinction (McElhany et al. 2007). Pre-spawn mortality rates are high, abundances of successful natural-origin (wild) spawners are low, and recent use of natural spawning areas has been dominated by fish of hatchery origin (Schroeder et al. 2006). The wild component of the spawning population is not thought to be self-sustaining (Good et al. 2005).

Adult UWR Chinook returning to the North Santiam River are counted as they pass over Bennett Dam (at RM 31.5) and later if they are captured in a fish trap (Minto Trap) at a hatchery barrier dam about 3 miles below Big Cliff. Figure 4.6-3 gives the numbers of adult Chinook salmon counted at Minto Trap (above all natural spawning areas accessible to the North Santiam population) each year from 1981-2006. Fish arriving at the trap are predominantly hatchery fish, but the extent to which hatchery fish outnumber natural-origin (wild) ones at the trap has only become certain within the last decade as improvements have been made to fish marking and monitoring efforts in the Willamette Basin. Annual counts of adult UWR Chinook at Minto Trap have risen erratically since the early 1980s, perhaps in part due to more effective collections of the fish that accumulate at the barrier dam, and averaged 3,887 fish during the most recent 5-year period. An average of 239 (6%) of the fish counted at the trap during this recent period were classified as wild (McLaughlin et al. 2008). These wild fish were either incorporated into the local hatchery broodstock or released into spawning areas on the Little North Santiam River (McLaughlin et al. 2008).

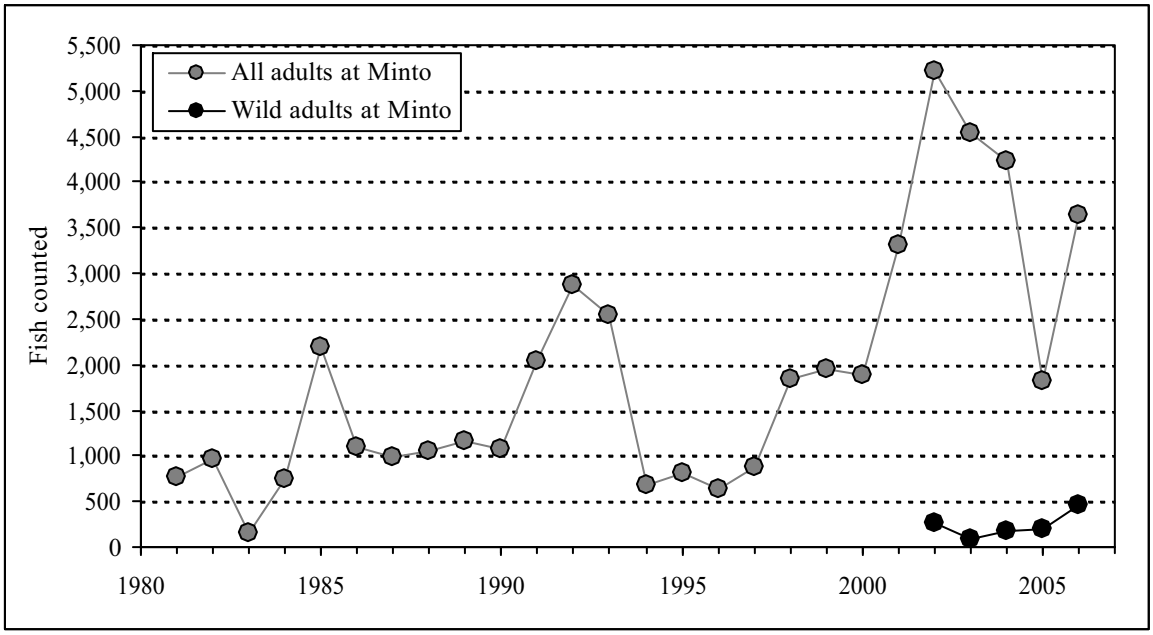

Figure 4.6-3 Annual returns of spring Chinook salmon to Minto Trap on the North Santiam River at RM 31.5 from 1984-2006 (StreamNet trend no. 50969), including 2002-2006 estimates of the wild component that were developed by McLaughlin et al. (2008).

During 2001-2005, the most recent 5-year period for which annual counts of UWR Chinook passing over Bennett Dam are available, numbers of wild adults ranged from 220 to 667 and averaged 450 fish (McLaughlin et al. 2008, Table 4.6-1). These wild fish accounted for an average of 6% of all adults passing the dam during this period, the same fraction seen recently in the catch at Minto Trap (see above). Wild fish passing Bennett Dam but not later counted at Minto Trap either spawn successfully in the North or Little North Santiam Rivers or die prior to doing so.

Table 4.6-1 Estimated numbers of wild and hatchery-origin adult UWR Chinook passing upstream at Bennett Dam, North Santiam River, 2001-2005, as determined by analyses of otoliths in non fin-clipped fish and coded wire tags in fin-clipped fish (McLaughlin et al. 2008).

Year	Number of wild adults	Number of hatchery-origin adults	Total adults passing upstream at Bennett Dam	Percent wild
2001	220	6,566	6,786	3
2002	604	7,036	7,640	8
2003	271	12,561	12,832	2
2004	489	13,042	13,531	4
2005	667	4,216	4,883	14
5- year average	450	8,684	9,134	6

Under contract to the USACE, ODFW has since 2001 conducted intensive monitoring of the spawning grounds of UWR Chinook in the North Santiam and Little North Santiam rivers. Monitoring results from 2001 through 2006 showed that annual pre-spawn mortality rates of these fish were high in both the North Santiam (mean = 59%) and Little North Santiam (mean = 51%), and that an average of 90% of the spawners along the mainstem and 49% of those in the Little North Santiam were of hatchery origin (McLaughlin et al. 2008). Further, the numbers of successful spawners appear likely to have included an average of fewer than 100 wild adults in each river. Extended over the long term, the combination of low abundance of wild adults, high pre-spawn mortality, and high percentages of hatchery fish in spawning areas, would make it improbable that the river's "wild" run could include many individuals more than a few generations removed from the hatchery.

Recent counts of UWR Chinook redds (nests) in known spawning areas on the North Santiam and Little North Santiam rivers are given in Table 4.6-2. An average of 302 redds (range: 144-661) has been counted annually in the two rivers from 1997 through 2006, with nearly 90% of these redds seen in the North Santiam (ODFW 2007a).

The intensity of UWR Chinook use of spawning areas within the North Santiam itself is strongly skewed toward the reach of river immediately below the barrier dam at Minto (Schroeder et al. 2006). The concentration of spawners in areas relatively closer to Big Cliff would seem to increase the potential for the USACE dams and their reservoirs to affect fish survival (hence productivity) by influencing water quality, flow, or physical habitat conditions.

Year	North Santiam R. (Stayton to Minto)	Little North Santiam R.	Total
1997	134	10	144
1998	155	39	194
1999	215	11	226
2000	272	22	294
2001	308	18	326
2002	276	30	306
2003	630	31	661
2004	283	51	334
2005	240	61	301
2006	202	34	236
10-year average	272	31	302

Table 4.6-2 Counts of spring Chinook salmon redds in the North Santiam and Little North Santiam rivers, 1997-2006 (ODFW 2007a).

Spatial Structure

The reduced access of spring Chinook in the North Santiam subbasin to high-quality habitats reflects a high or very high extinction risk. Mattson (1948) estimated that 71% of the spring Chinook production in the North Santiam subbasin occurred above the current sites of USACE dams. More recently, ODFW (2005b) estimated that 42% of the historically suitable habitat for spring Chinook is now inaccessible. However, the now inaccessible areas were high quality habitats, and the primary spawning areas in the North Santiam (McElhany et al. 2007). Much of the remaining habitat is not well-suited for spring Chinook, although some favorable reaches may still be found in the Little North Santiam.

Diversity

Diversity-related risks posed by losses of life history traits, low effective population size, hatchery impacts, anthropogenic mortality, and habitat diversity, can affect the viability of salmonid populations. McElhany et al. (2007) considered such risks to pose a high risk of extinction for the North Santiam population of UWR Chinook. Their primary concerns in this regard included known changes in spawn, emergence, and juvenile migration timing (Myers et al. 2002), the small size of the naturally-produced spawning component, and the potential for hatchery domestication.

4.6.2.2 UWR Steelhead

Population Viability

McElhany et al. (2007) have rated the North Santiam population of UWR steelhead as being at low to moderate risk of extinction with considerable uncertainty, based on an assessment of its abundance, productivity, spatial structure, and diversity. Key chronic risk factors include reductions in spatial structure caused by USACE dams, reduced habitat diversity, genetic

4.10.2.2 UWR Steelhead

The same flow conditions at Willamette Falls that once limited access to all but spring-run Chinook salmon also provided an isolating mechanism for late-run winter steelhead. Fish belonging to populations of UWR Steelhead group of fish enter the Willamette beginning in January and February, but adults do not ascend to their spawning areas until late March or April (Dimick and Merryfield 1945). UWR Steelhead use the mainstem Willamette primarily as a migration corridor on their way to spawning and rearing habitat in the tributaries (ODFW 1990d; Fulton 1970). Spawning takes place from April to the first of June. The ODFW currently uses an artificial passage date at Willamette Falls, February 15th, to discriminate between native versus nonnative (i.e., naturalized Big Creek hatchery stock) winter steelhead (Kostow 1995).1

Emigration of native winter steelhead smolts past Willamette Falls begins in early April and extends through early June (Howell et al. 1985), with peak migration occurring in early to mid-May. Mean lengths of naturally-produced smolts sampled weekly at Willamette Falls (1976 through 1978) ranged from 170 mm to 220 mm. Larger smolts migrated significantly earlier than the smaller smolts (Buchanan et al. 1979).

Sampling by ODFW along the lower Willamette, below Willamette Falls, during 2000 through 2003 showed steelhead smolts to be present during winter and spring (Friesen 2005). The fish were generally larger at the lower end of the river than they were at the upper end, suggesting that the fish were growing as they traveled downriver. Smolts radio-tagged and tracked through the river below the Falls during 2001-2003 had median migration rates of 12.5 km/d and median residence times of 2.5 d (Friesen 2005).

As with Chinook, steelhead smolts migrated downriver more often through Multnomah Channel than out the mouth of the Willamette River (Knutsen and Ward 1991). Smolt migration rates were positively correlated with river flows (Friesen 2005).

Population Viability

The UWR steelhead ESU includes all naturally spawned populations of winter-run steelhead in the Willamette River in Oregon and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive) (NMFS 1999b). It does not include any artificially propagated steelhead stocks that reside within the historical geographic range of the ESU. Hatchery summer steelheads occur in the Willamette Basin, but are an out-of-basin stock not included in the ESU.

The WCSBRT was encouraged by recent significant increases in returns of adult UWR steelhead (exceeding 10,000 total fish) in 2001 and 2002 for the UWR steelhead ESU. However, the recent five-year mean abundance remains low for an entire ESU (5,819 adults), and individual populations remain at low abundance. Long-term trends in abundance are negative for all populations in the ESU, reflecting a decade of consistently low returns during the 1990s. Short-term trends, buoyed by recent strong returns, are positive.

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[1] Stone (1878) reported that steelhead began arriving at the base of Willamette Falls around Christmas, but were most abundant in April. Additionally, the spawning peak was reported to be in May, with spawning complete by June.

About one-third of the ESU's historically accessible spawning habitat is now blocked, but it remains relatively well-distributed spatially within accessible areas within each of its four natal subbasins (Good et al. 2005). The WCSBRT considered the relatively recent cessation of the early-winter-run hatchery program a positive sign for ESU diversity risk, but remained concerned that releases of non-native summer steelhead continue. The WCSBRT found moderate risks for each of the VSP categories.

4.10.2.3 LCR Chinook Salmon

Use of the lower Clackamas, below Willamette Falls, by LCR Chinook salmon is presumed to be relatively similar to that described for UWR Chinook except that upstream migrations of adults might occur during late summer and fall, while juvenile emigration would likely be restricted to sub-yearling fish rearing in and passing through the area during late winter, spring, and early summer.

Population Viability

Many populations within the LCR Chinook salmon ESU have exhibited pronounced increases in abundance and productivity in recent years, possibly due to improved ocean conditions. However, despite recent improvements, long-term trends in productivity are below replacement for the majority of populations in the ESU. Of the historical populations, 8 to 10 have been extirpated or nearly extirpated, including the population that once spawned in the Clackamas River and a few of the smaller Willamette tributaries below Willamette Falls.

The WCSBRT found moderately high risk for all VSP categories. High hatchery production poses genetic and ecological risks to the natural populations and complicates assessments of their performance. The WCSBRT also expressed concern over the introgression of out-of-ESU hatchery stocks.

4.10.2.4 LCR Steelhead

LCR steelhead from the Clackamas subbasin and nearby streams migrate upriver through the lower Willamette River as adults during winter and spring. They emigrate through the lower River as smolts during late winter and spring. Their behavior while in the lower Willamette is as described for UWR Steelhead.

Population Viability

The current status of this evolutionary group of populations was described earlier, in section 3.2.2.3 (Rangewide status, LCR steelhead), with additional detail on the Clackamas population provided in section 4.8.2, Clackamas subbasin baseline. The WCSBRT found moderate risks of extinction associated with the abundance, productivity, spatial structure, and diversity of the group's component populations. Particular concerns included the impact on diversity or productivity of high proportions of hatchery-origin spawners in natural spawning areas and the potential for competitive displacement of native winter-run fish by the offspring of stray spawners from hatchery releases of nonnative hatchery summer steelhead.

Section 5.2.1 Habitat Access/Fish Passage), further degradation of physical habitat characteristics would reduce what little habitat remains available to the UWR Chinook salmon population in the Middle Fork Willamette subbasin.

The extent and function of the Middle Fork Willamette subbasin's riparian vegetation and floodplains have been and would continue to be impaired by operation of the Willamette Project under the proposed action. Hills Creek Reservoir inundated approximately 200 acres of riparian hardwoods, while Lookout Point and Dexter reservoirs inundated another 2,025 acres of riparian forest along the Middle Fork Willamette River. Fall Creek Reservoir inundated approximately 6.8 miles of riparian vegetation along Fall Creek. USACE revetments replaced approximately 4 miles of riparian vegetation along the Middle Fork Willamette River, such that 50% of the banks below river mile 19 are hardened (USACE 1989b). 1.47 miles of these revetments would be maintained by the USACE under the proposed action.

The flood control afforded by the Willamette Project in the Middle Fork Willamette subbasin has probably increased development within the floodplain and indirectly facilitated clearing of riparian vegetation for agricultural, residential, and urban development, and this effect would continue under the proposed action. However, additional development in the floodplain is at the discretion of private parties, so these effects are discussed in Chapter 6 (Cumulative Effects).

As described above in sections 5.2.4.1, operation of Hills Creek, Lookout Point, Dexter, and Fall Creek dams would continue to trap gravel and large wood and reduce the magnitude of peak flows in the Middle Fork Willamette subbasin. Both of these operations deprive downstream reaches of material and transport mechanisms needed to create new gravel bars and floodplains on which new riparian vegetation can establish. Additionally, USACE revetments would continue to prevent river migration and contribution of sediment from 1.47 miles of streambank in the lower Middle Fork Willamette, further depriving the river of sediment and the ability to construct new surfaces on which riparian vegetation can establish.

Conclusion

The proposed operation of the Willamette Project would continue to reduce the extent, quality, and inundation frequency of riparian and floodplain forests in the Middle Fork Willamette subbasin downstream of Dexter and Fall Creek dams. This limits recruitment of large wood into the aquatic system, which is needed to deposit spawning gravel, create resting pools for migrating adults, and provide cover for rearing juveniles or outmigrating smolts. Reduced inundation of forested floodplains limits nutrient and organic matter exchange during flood events, and reduces the availability of high-water refugia for juveniles, which could limit over-wintering survival of rearing juveniles. Aside from unspecified habitat restoration actions that may result from the Willamette Floodplain Restoration Study, the Action Agencies do not propose any measures that would restore riparian vegetation and floodplain connectivity in the Middle Fork Willamette subbasin. Given the lack of upstream and downstream passage to historical habitat above Project dams, and the limited habitat below the dams for spawning, rearing, and holding, continued degradation of this habitat under the Proposed Action would put the Middle Fork Willamette population of UWR Chinook salmon at even higher risk of extinction than its current status.

mechanisms needed to create new gravel bars and floodplains on which new riparian vegetation can establish. Additionally, USACE revetments will continue to prevent river migration and contribution of sediment from 4.17 miles of streambank along the lower McKenzie, further depriving the river of sediment and the ability to construct new surfaces on which riparian vegetation can establish. The reduced width of riparian forests could prevent shading of the McKenzie River, which could allow summer water temperatures to increase.

In summary, the proposed operation of the Willamette Project will continue to reduce the extent, quality, and inundation frequency of riparian and floodplain forests in the McKenzie River subbasin downstream of Cougar and Blue River dams. This limits recruitment of large wood into the aquatic system, which is needed to deposit spawning gravel, create resting pools for migrating adults, and provide cover for rearing juveniles or outmigrating smolts. Reduced inundation of forested floodplains reduces nutrient and organic matter exchange during flood events, and reduces the availability of high-water refugia for juveniles, which could limit over-wintering survival of rearing juveniles. Aside from unspecified habitat restoration actions that may result from the Willamette Floodplain Restoration Study or other habitat restoration studies described in the Sup BA, Section 3.5.2, Offsite Habitat Restoration Actions (USACE 2007a), the Action Agencies do not propose any measures that would restore riparian vegetation and floodplain connectivity in the McKenzie River subbasin. Given the uncertainty in upstream and downstream passage to historical habitat above Cougar Dam (see Section 5.3.1), continued degradation of limited spawning and rearing habitat under the Proposed Action will put the McKenzie subbasin population of UWR Chinook salmon at even higher risk of extinction than its current status.

5.3.5 Hatcheries

As described in Chapter 2, the Proposed Action is to continue to artificially propagate hatchery spring Chinook salmon (ODFW stock # 23) and summer steelhead (ODFW stock # 24) and release these fish into the McKenzie River at McKenzie and Leaburg Hatcheries. Details about these programs are described in the McKenzie spring Chinook HGMP (ODFW 2007a) and Willamette Basin summer steelhead HGMP (ODFW 2004a).

Below is an analysis of the specific effects of these actions on listed spring Chinook in the McKenzie River.

5.3.5.1 Hatchery Operations

There are three hatchery-related facilities located within the McKenzie River watershed: 1) McKenzie Hatchery, 2) Leaburg Hatchery, and 3) fish trap at Leaburg Dam. McKenzie Hatchery collects, spawns, incubates, and rears spring Chinook salmon for the McKenzie River hatchery program. Broodstock are collected at this hatchery and also at a trap in the fish ladder at Leaburg Dam when necessary. The Leaburg Hatchery rears and releases resident rainbow trout and summer steelhead into the McKenzie River.

As described above in the "General effects of hatchery programs on ESA-listed salmon and steelhead" section 5.1 above, there are two primary concerns with the effects of hatchery

7.2.2.2 Juvenile Rearing Habitat

Juvenile Chinook salmon require freshwater rearing areas with adequate flows and floodplain connectivity, water quality, forage, natural cover to support juvenile survival and growth and development. Juveniles also require safe passage through migration corridors to assure completion of the anadromous life cycle. As discussed in Chapter 5, in subbasins with Willamette Project dams (Coast Fork and Middle Fork Willamette, McKenzie, Long Tom, and South and North Santiam), operations alter the seasonal hydrograph and water temperatures, block the transport of gravel and large wood, and separate the channel from its floodplain. Flow operations also reduce the productivity of rearing habitat at the channel margins and ramping operations have the potential to strand and entrap fry in shallow areas. In subbasins without Project dams (Calapooia, Molalla, and Clackamas), revetments cause some of the same problems with respect to floodplain habitat and channel structure as flow operations, although these are relatively local in scale.

7.2.3 Actions Needed to Improve Population & ESU Viability & the Conservation Value of Critical Habitat

NMFS is consulting on the continued operation of the Willamette Project including the maintenance of 42 miles of revetments and the associated hatchery mitigation program, as described in Chapter 2. This section focuses on whether the Proposed Action addresses the effects of the Project by eliminating, reducing, or offsetting effects on UWR Chinook and the PCEs of critical habitat. The following is a subbasin-by-subbasin rationale for the major actions that would address the effects of the Project, based upon the assessment above and in Chapters 4 (historical effects of the Project) and 5 (effects of the Proposed Action). These actions are compared with those in the Proposed Action (Chapter 2).

Middle Fork Willamette

- The Middle Fork Willamette Chinook population is at a high risk of extinction. Key limiting factors include loss of access to 95% of the historical oversummering and spawning habitat above Willamette Project dams, elevated late-summer and fall temperatures in the mainstem below Dexter Dam and in the lower reaches of Fall Creek, and the risk of genetic introgression from hatchery-origin Chinook interbreeding with the natural-origin population.
- The limited spawning habitat below the dams does not produce significant numbers of Chinook due to the effects of elevated late-summer and fall temperatures (high prespawning and embryo mortality, premature hatching and emergence). *The Proposed Action does not include temperature control at these projects.*
- The existing facilities for trap and haul at Fall Creek and broodstock collection below Dexter Dam must improve so that more adult Chinook survive to spawn in the high quality habitat upstream. The Supplemental BA recognizes the need for these improvements, but *the Proposed Action does not include an implementation schedule.*
- Juvenile salmon survival through the reservoirs and dams must increase, but *the Proposed Action does not set an implementation schedule for downstream passage improvements at any of the Middle Fork projects.*

- Hills Creek Reservoir will continue to be managed to meet or exceed minimum outflows and Fall Creek and Dexter reservoirs will be managed to meet minimum and maximum outflows, protecting adult access to downstream spawning habitat, eggs deposited during spawning, and rearing habitat. These operations will depend on available reservoir storage and inflow and will be consistent with flood damage reduction and public safety requirements. The Proposed Action includes compliance and effectiveness monitoring for instream flows, *but insufficiently defines NMFS' role in ensuring that any changes in these objectives meet the habitat needs of anadromous fish*.
- Specific hourly and daily ramp-down rates will be followed at Hills Creek, Lookout Point, and Fall Creek dams to prevent desiccation of redds and entrapment and stranding of juvenile Chinook. These operations will be consistent with other project purposes such as those for flood damage reduction.

McKenzie

- The McKenzie Chinook population is at a moderate risk of extinction. It is currently the largest in the ESU, with thousands of natural-origin fish returning on average. At present, the risk of genetic introgression by hatchery-origin fish and the loss of access to historical habitat above Cougar Dam are the two key limiting factors for this population that are related to the Willamette Project.
- To protect and conserve genetic integrity within the natural-origin population, the percentage of hatchery-origin Chinook spawning with natural-origin fish must be reduced. The best location to remove hatchery fish is at Leaburg Dam, located downstream from the areas with the majority of the natural spawning. *The Proposed Action does not set an implementation schedule for constructing a trap at Leaburg Dam.*
- Historically, the South Fork of the McKenzie River produced a significant number of Chinook. All of this production was eliminated by the Willamette Project (Cougar Dam). Improvements to the adult trap-and-haul program and to downstream juvenile survival through the reservoir and dam will be necessary to sustain production over the long-term. The Proposed Action does include a commitment to build and operate a new adult trap at Cougar Dam during FY2008 (revised to 2009 due to change in construction schedule), but *does not include an implementation schedule for improving juvenile reservoir and project passage.*
- Historically, the spawning habitat in the South Fork McKenzie below Cougar Dam did not produce significant numbers of Chinook due to the effects of elevated late-summer and fall temperatures (high prespawning and embryo mortality, premature hatching and emergence). The USACE completed construction of a water temperature control tower at Cougar in December 2004 which has been fully operational since 2005. Under the Proposed Action, the Action Agencies will continue to operate the Cougar Water Temperature Control tower.
- Blue River Reservoir will continue to be managed to meet or exceed minimum outflows and Cougar Reservoir will be managed to meet minimum and maximum outflows, protecting adult access to downstream spawning habitat, eggs deposited during spawning, and rearing habitat. These operations will also depend on available reservoir storage and inflow and will be consistent with flood damage reduction and public safety requirements. The Proposed Action includes compliance and effective monitoring for instream flows, *but insufficiently*

defines NMFS' role in ensuring that any changes in these objectives meet the habitat needs of anadromous fish.

- Specific hourly and daily ramp-down rates will be followed at Blue River and Cougar dams to prevent desiccation of redds and entrapment and stranding of juvenile Chinook. These operations will be consistent with other project purposes such as those for flood damage reduction.

Calapooia

- The Calapooia Chinook population is at a high risk of extinction. The risk of genetic introgression due to a high proportion of hatchery strays spawning with natural-origin Chinook is a key limiting factor. However, all releases of hatchery-origin Chinook in the subbasin were discontinued after 2003.
- Habitat in the lower reaches is affected by revetments, which reduce the functioning of rearing habitat, but there are no Project dams in the subbasin.

South Santiam

- The South Santiam Chinook population is at a high risk of extinction. At present, the risk of genetic introgression by hatchery-origin fish, the loss of access to 85% of the historical habitat oversummering and spawning habitat above Foster and Green Peter dams, and elevated late-summer and fall water temperatures in the mainstem below Foster are the key limiting factors for this population that are related to the Willamette Project.
- The spawning habitat below the dams will not produce significant numbers of Chinook due to the effects of elevated late-summer and fall temperatures (high prespawning mortality, premature hatching and emergence). *The Proposed Action does not include temperature control at these projects.*
- The existing facilities for trap and haul at Foster Dam must improve so that more adult Chinook can reproduce successfully in the higher quality habitat upstream. The Supplemental BA (USACE 2007a) recognizes the need for rebuilding the Foster collection facility, but *the Proposed Action does not set an implementation schedule*.
- Juvenile Chinook survival through Foster Dam and reservoir must also increase, and passage at Green Peter must be evaluated. The Proposed Action includes continuation of a one-month spring spill program at Foster Dam, which provides higher survival than through the turbines, but *does not include measures to address reservoir and dam passage survival throughout the juvenile migration period*.
- Foster Reservoir will continue to be managed to meet minimum and maximum outflows, protecting adult access to downstream spawning habitat, eggs deposited during spawning, and rearing habitat. These operations will also depend on available reservoir storage and inflow and will be consistent with flood damage reduction and public safety requirements. The Proposed Action includes compliance and effective monitoring for instream flows, *but insufficiently defines NMFS' role in ensuring that any changes in these objectives meet the habitat needs of anadromous fish*.
- Specific hourly and daily ramp-down rates will be followed at Foster Dam to prevent desiccation of redds and entrapment and stranding of juvenile Chinook. These operations will be consistent with other project purposes such as flood damage reduction operations.

North Santiam

- The North Santiam Chinook population is at a high risk of extinction. The risk of genetic introgression by hatchery-origin fish, the loss of access to 71% of the historical habitat oversummering and spawning habitat above Big Cliff and Detroit dams, and elevated late-summer and fall temperatures in the mainstem below Big Cliff are the key limiting factors for this population that are related to the Willamette Project.
- Based on the number of miles available, the North Santiam River below Project dams has a high potential for re-establishing natural Chinook production. However, elevated late-summer and fall temperatures result in high prespawning and embryo mortality and premature hatching and emergence. *The Proposed Action does not include temperature control at these projects.*
- The existing facilities for broodstock collection and adult trap and haul at the Minto barrier dam must improve so that adult Chinook can be successfully outplanted in the higher quality habitat upstream. Under the Proposed Action, construction on an upgraded facility will begin in FY 2010.
- Concurrently, actions must be implemented to increase juvenile salmon survival through the Detroit and Big Cliff reservoirs and dams. The Proposed Action includes studies, but *without an implementation schedule for either the studies or for providing juvenile passage at either dam.*
- Big Cliff Reservoir will continue to be managed to meet minimum and maximum outflows, protecting adult access to downstream spawning habitat, eggs deposited during spawning, and rearing habitat. These operations will also depend on available reservoir storage and inflow and will be consistent with flood damage reduction and public safety requirements. The Proposed Action includes compliance and effective monitoring for instream flows, *but insufficiently defines NMFS' role in ensuring that any changes in these objectives meet the habitat needs of anadromous fish*.
- Specific hourly and daily ramp-down rates will be followed at Detroit Dam to prevent desiccation of redds and entrapment and stranding of juvenile Chinook. These operations will be consistent with other project purposes such as flood damage reduction operations.

Molalla

- The Molalla Chinook population is at a high risk of extinction. The risk of genetic introgression by an out-of-basin hatchery stock is a key limiting factor for this population.
- The most important short-term action that could be taken to increase the viability of this population is to eliminate the use of an out-of-population hatchery broodstock and then to implement a better designed supplementation program for 2-3 generations to boost spawning escapement. Eventually, the hatchery program would be discontinued so that the viability of the naturally-produced population could be determined in the absence of artificial propagation. This problem is *not addressed in the Proposed Action*.
- Habitat in the lower reaches is affected by revetments, which reduce the functioning of rearing habitat, but there are no Project dams in the subbasin.

Clackamas

- The Clackamas Chinook population is at a moderate risk of extinction.
- Habitat in the lower reaches is affected by revetments, which reduce the functioning of rearing habitat, but there are no Project dams in the subbasin.

Coast Fork Willamette

- The Coast Fork Willamette does not support an independent population of Chinook. Some outplanted hatchery-origin Chinook have successfully reproduced in Mosby Creek, a tributary to the Row River below Dorena Dam.
- Specific hourly and daily ramp-down rates will be followed at Cottage Grove and Dorena dams to protect juvenile outmigrants from Mosby Creek and juvenile rearing habitat in the lower reaches whenever possible, consistent with other project purposes such as flood damage reduction.

Long Tom

- Chinook use of the Long Tom is limited to juvenile Chinook rearing and overwintering.
- Specific hourly and daily ramp-down rates will be followed at Fern Ridge Dam to protect juvenile rearing habitat in the lower reaches whenever possible, consistent with other project purposes such as flood damage reduction.

Mainstem Willamette River

- The Proposed Action would continue to operate the Project to meet minimum and maximum mainstem flow objectives at Albany and Salem including both the statutorily authorized minimum flows for June through October and new "fish flow" objectives for April through June. Risks associated with meeting multiple uses for Willamette Basin flow and storage, including the needs of ESA-listed fish species, will be balanced during water years deemed as having "insufficient" or "deficit" volumes available.
- The Proposed Action would continue to adversely affect mainstem Willamette River Chinook rearing and migration habitat. Operation of the dams to control floods and maintaining revetments would continue to disconnect the floodplain from the mainstem river over most of its length. Aquatic habitat within the remaining stream channel is degraded by lack of complexity from large wood, sediment transport, and channelization.
- The Proposed Action includes an evaluation of floodplain restoration, but *does not include actions that would restore floodplain connections, protect the highest quality riparian habitat, or otherwise restore habitat quality in the mainstem.*
- The Proposed Action includes an evaluation of the biological impacts of revetments, but *without an implementation schedule for habitat improvement or restoration.*
- The Proposed Action includes an evaluation of the biological impacts of revetments, in the occupied subbasins and in the mainstem Willamette, but *without an implementation schedule for habitat improvement or restoration.*

- Effects of the Proposed Action are limited to very small changes in river discharge with slight to negligible effects on flow-related fish habitat.

7.3 UWR STEELHEAD

7.3.1 Current Status

The four populations in the UWR steelhead DPS are currently at moderate risk of extinction (Figure 3-7). However, there are wide confidence intervals around the viability estimates for each population due to uncertainty in the data on their status (Section 3.2.2.3). Long-term trends in abundance suggest declining populations (Table 3-9), but short-term trends are positive (McElhany et al. 2007). The status of PCEs of designated critical habitat is poor, although the degree to which habitat is deficient varies among subbasins (see Tables 4.4-2, 4.5-5, 4.6-8, and 4.7-4).

7.3.2 Effects of the Proposed Action on Population Viability & PCEs of Critical Habitat

Significant differences in the life histories and habitat requirements of winter steelhead versus spring Chinook explain why the winter steelhead populations are in better shape with respect to viability. As described above, spring Chinook evolved using streams that receive substantial snowmelt from headwaters in the Cascade Mountains. They held and spawned in cold water, a component of their life-history now made difficult in several subbasins by Project dams without passage, altered thermal regimes below these dams, or both. In contrast, winter steelhead, migrate to their natal streams in late winter/early spring and spawn almost immediately. Spawning streams range in size from very small streams to larger rivers. With spawning and rearing distributed over a larger area, the adverse effects of Willamette Project influence a smaller proportion of each steelhead population's habitat than is the case for spring Chinook.

Two of the four steelhead populations in the Upper Willamette River DPS are directly affected by Willamette Project dams and reservoirs. The North Santiam and South Santiam are large watersheds, and the steelhead in these tributaries were identified as "core" populations by the WLCTRT. The other two subbasins supporting independent populations of UWR steelhead (Molalla and Calapooia) do not contain large, high-head, USACE dams, but experience minor effects of the Project due to maintenance of revetments.

The South Santiam steelhead population currently ranks as having the lowest risk of extinction in the DPS. The South Santiam has the largest amount of steelhead habitat volitionally accessible, with over 930 miles of stream habitat accessible below and above Foster Dam (Maher et al. 2005). Most of this spawning and juvenile rearing habitat is located in tributaries to the South Santiam River below the Project dams (Thomas, Crabtree, and Wiley creeks). In addition, the trap and haul program for natural-origin steelhead at Foster Dam has been in operation since the dam was constructed, which has allowed steelhead to use the historical habitat upstream for natural production. Even though the upstream passage facilities at Foster Dam need upgrading to reduce rates of injury and mortality (Section 4.5.3.1), some of these adults spawn successfully

because significant numbers of steelhead smolts emigrate downstream. Improvements to the upstream and downstream passage facilities and operations at Foster Dam would increase the productivity of the natural-origin steelhead spawning in the upper South Santiam as well as the survival of kelts migrating back to the ocean.

In contrast, steelhead in the North Santiam only have access to about 400 miles of stream habitat, all below Detroit and Big Cliff dams. Almost 620 miles of historical stream habitat above Big Cliff/Detroit dams (Maher et al. 2005) are currently inaccessible, but no steelhead are passed upstream. Other than the mainstem below these dams, only one large tributary, the Little North Santiam River, provides significant steelhead habitat. The continued operation of the Willamette Project under the Proposed Action would continue to exclude steelhead from much of the historical habitat above Detroit/Big Cliff dams and to expose incubating eggs and young fry to colder water temperatures below the dams, which delays emergence and reduces growth.

The Molalla and Calapooia populations face a different suite of limiting factors and threats compared to those in the Santiam system (see Chapter 4 and ODFW 2007a). The Calapooia subbasin is relatively small and thus steelhead habitat is relatively limited. In addition, the lower elevations of the Calapooia are surrounded by agricultural land (Maher et al. 2005). Land management activities associated with timber harvest and agriculture are the primary threats to this population. A similar situation exists in the Molalla subbasin. However, the Molalla is a much larger watershed, which currently has over 870 miles of stream habitat available to steelhead (Maher et al. 2005) and therefore a much greater production potential. For both of these populations, protection of the highest quality remaining habitat, combined with habitat restoration, will be necessary to improve their status. Incidental fishery harvest rates (typically 1-3%, including hook-and-release mortality) are already reduced to a very low level.

7.3.3 Actions Needed to Improve Population & DPS Viability & the Conservation Value of Critical Habitat

This section focuses on whether the Proposed Action addresses the effects of the Project by eliminating, reducing or offsetting effects of UWR steelhead and the PCEs of critical habitat. The following is a subbasin-by-subbasin rationale for the major actions that would address the effects of the Project, based upon the assessment above and in Chapters 4 (historical effects of the Project) and 5 (effects of the Proposed Action). These actions are compared with those in the Proposed Action (Chapter 2).

Calapooia

- The Calapooia steelhead population is at a moderate risk of extinction.
- Habitat in the lower reaches is affected by revetments, but there are no Project dams in the subbasin.

South Santiam

- The South Santiam steelhead population is at a moderate risk of extinction and is one of the largest in the DPS. The trap and haul program at Foster Dam has allowed natural-origin fish to continue to use most of their historical upstream habitat (although approximately 17% remains blocked by Green Peter Dam).

- The ladder, trap, and methods for handling fish at the collection facility at Foster Dam cause delay, injury, and stress. These problems are compounded by the overlap in run timing of natural-origin steelhead with those of hatchery Chinook and steelhead. The facility therefore must be upgraded to allow more efficient capture and handling of listed steelhead. The Supplemental BA (USACE 2007a) recognizes the need for rebuilding the Foster Trap, but the Proposed Action *does not set an implementation schedule*.
- Actions must also be taken to increase downstream juvenile steelhead and kelt survival through Foster Reservoir and Dam. The Proposed Action includes continuation of a one-month spring spill program at Foster Dam, which provides higher survival than through the turbines, but *does not include measures to address reservoir and dam survival throughout the juvenile migration period and when kelts are likely to be moving downstream*.
- Colder than normal water temperatures during spring delay hatching and emergence of juvenile steelhead in the mainstem South Santiam below Foster. The Proposed Action *does not include temperature control at Green Peter or Foster Dam*.
- Foster Reservoir will continue to be managed to meet minimum and maximum outflows, protecting adult access to downstream spawning habitat and eggs deposited during spawning. These operations will depend on available reservoir storage and inflow and will be consistent with flood damage reduction and public safety requirements. The Proposed Action includes compliance and effectiveness monitoring for instream flows, *but insufficiently defines NMFS' role in ensuring that any changes in these objectives meet the habitat needs of anadromous fish*.
- Specific hourly and daily ramp-down rates will be followed at Foster to prevent entrapment and stranding of juvenile steelhead. These operations will be consistent with other project purposes such as flood damage reduction operations.
- The risks to population viability associated with the hatchery summer steelhead program must be reduced. The Proposed Action includes studies of the proportion of natural-origin juvenile steelhead that are the progeny of summer steelhead and a commitment to assess the summer steelhead recycling protocol, but lacks the specific measures needed to address these problems.

North Santiam

- The North Santiam steelhead population is currently at a moderate risk of extinction. Key threats and limiting factors related to the Willamette Project include loss of access to historical spawning and rearing habitat above Big Cliff/Detroit dams and risks associated with the out-of-basin summer steelhead hatchery program.
- Unmarked winter steelhead captured at Minto are released upstream of the barrier dam, but below Big Cliff. Cold water temperatures during spring delay hatching and emergence and elevated gas levels from flow operations can adversely affect the eggs, larvae, and fry. The Proposed Action *does not include temperature control at Detroit/Big Cliff dams or measures to reduce the frequency and duration of elevated gas levels*.
- At present, steelhead have not been reintroduced back into historical habitat blocked by Project dams. A risk/benefit assessment should be completed to assess whether reintroduction efforts would increase the viability of this population *but the Proposed Action does not include a commitment to this effort*.

- Big Cliff Reservoir will continue to be managed to meet minimum and maximum outflows, protecting adult access to downstream spawning habitat, eggs deposited during spawning, and rearing habitat. These operations will depend on available reservoir storage and inflow and will be consistent with flood damage reduction and public safety requirements. The Proposed Action includes compliance and effectiveness monitoring for instream flows, *but insufficiently defines NMFS' role in ensuring that any changes in these objectives meet the habitat needs of anadromous fish*.
- Specific hourly and daily ramp-down rates will be followed at Detroit Dam to prevent entrapment and stranding of juvenile steelhead. These operations will be consistent with other Project purposes such as flood damage operations.
- The risks to population viability associated with the hatchery summer steelhead program must be reduced. The Proposed Action includes studies of the proportion of natural-origin juvenile steelhead that are the progeny of summer steelhead and a commitment to scale back summer steelhead recycling efforts no later than 2008, which will reduce the potential for adverse interactions with native winter steelhead.

Molalla

- The Molalla steelhead population is at a moderate risk of extinction.
- Habitat in the lower reaches is affected by revetments, which reduce the functioning of rearing habitat, but there are no Project dams in the subbasin.

Mainstem Willamette River

- The Proposed Action would continue to operate the Project to meet minimum and maximum mainstem flow objectives at Albany and Salem including both the statutorily authorized minimum flows for June through October and new "fish flow" objectives for April through June. Risks associated with meeting multiple uses for Willamette Basin flow and storage, including the needs of ESA-listed fish species, will be balanced during water years deemed as having "insufficient" or "deficit" volumes available.
- The Proposed Action would continue to adversely affect mainstem Willamette River steelhead rearing and migration habitat. Operation of the dams to control floods and maintaining revetments would continue to disconnect the floodplain from the mainstem river over most of its length. Aquatic habitat within the remaining stream channel is degraded by lack of complexity from large wood, sediment transport, and channelization.
- The Proposed Action *does not include actions that would restore floodplain connections, protect the highest quality riparian habitat, or otherwise restore habitat quality in the mainstem*.
- The Proposed Action includes an evaluation of the biological impacts of revetments, in the occupied subbasin and in the mainstem Willamette, but *without an implementation schedule for habitat improvement or restoration*.

Lower Columbia River, Estuary, Plume, and Coastal Ocean

- Effects of the Proposed Action are limited to modest changes in river discharge and changes in flow-related fish habitat. While small, these effects affect all of the species considered in this Opinion, including UWR steelhead.

- Effects of the Proposed Action add to much larger effects of other water developments in the Columbia basin on fish and fish habitat in the lower Columbia River, estuary, and plume.

7.4 Summary of Effects of the Proposed Action on UWR Chinook Salmon & UWR Steelhead

The Proposed Action does not adequately address the effects of the Willamette Project on UWR Chinook or steelhead. Principal deficiencies are:

- Chinook and steelhead populations important to the viability of their respective ESU/DPSs will be limited to use degraded spawning and rearing habitat below Project dams where space, water temperatures, and physical habitat conditions do not meet the species biological requirements
- Inadequate plan for upgrading adult collection facilities
- No plan for developing adequate downstream passage facilities for juveniles of either species and for steelhead kelts
- Lack of measures to improve rearing habitat affected by Project revetments
- Inadequate plan for reducing straying of hatchery-origin UWR Chinook into the area reserved for natural production above Leaburg Dam in the McKenzie subbasin
- Lack of specific measures to address the adverse effects of the summer steelhead hatchery program on listed fish

NMFS considers these deficiencies in its jeopardy analyses for UWR Chinook and steelhead in Sections 8.1 and 8.2.

7.5 Summary of Effects of the Proposed Action on Critical Habitat for UWR Chinook and UWR Steelhead

The Proposed Action does not adequately address the effects of the Willamette Project on critical habitat for UWR Chinook or steelhead. Principal deficiencies are:

- Spawning and rearing habitat will not have adequate water quality, floodplain connectivity, forage, and natural cover for the conservation of the species
- Inadequate plan for providing safe passage at adult collection facilities
- No plan for developing safe downstream passage facilities for juveniles of either species
- Lack of measures to improve floodplain connectivity and natural cover in rearing habitat affected by Project revetments

NMFS considers these deficiencies in its adverse modification (of critical habitat) analyses for UWR Chinook and steelhead in Sections 8.1 and 8.2.

8 CONCLUSIONS

The standards for determining jeopardy are set forth in Section 7(a)(2) of the ESA as defined by 50 C.F.R. Part 402 (the consultation regulations). Procedures for conducting consultation under section 7 of the ESA are further described in the Services' Consultation Handbook (USFWS and NMFS 1998). Jeopardy is defined as to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. Therefore it must determined, (a) whether the species can be expected to survive with an adequate potential for recovery under the effects of the action, the effects of the environmental baseline, and any cumulative effects, and (b) whether affected designated critical habitat is likely to remain functional (or retain the ability to become functional) to serve the intended conservation role for the species in the near and long term under the effects of the action, environmental baseline and any cumulative effects.

The analysis in the preceding sections of this Biological Opinion forms the basis for conclusions as to whether the Proposed Action, the ongoing operation and maintenance of the Willamette Project, including the mitigation hatchery program and maintenance of 42 miles of revetments, satisfies the standards of ESA Section 7(a)(2). To satisfy those standards, the Proposed Action must not be likely to jeopardize the continued existence of any listed species or destroy or adversely modify the designated critical habitat of such species. Chapter 3 of this opinion defines the current status of each of the 13 listed salmonid species and the status of critical habitat designated for 12 of the salmonid species. Chapter 4 evaluates the condition of the environmental baseline. Chapter 5 describes the likely effects of the Proposed Action on habitat condition, critical habitat, and the abundance, productivity, spatial structure, and genetic diversity of populations in the action area. Chapter 6 considers the cumulative effects of relevant non-Federal actions reasonably certain to occur within the action area. Chapter 7 synthesizes all of the relevant information in the baseline, effects, and cumulative effects chapters to assess effects of the Proposed Action on the listed species as a whole across its range and life cycle, and effects on designated critical habitat. On the basis of this information and analysis, NMFS draws its conclusions about the effects of the Proposed Action for the Willamette Project on the likelihood of survival and recovery of the 13 listed salmonid species that occupy the action area, and the likelihood that the Proposed Action will destroy or adversely modify designated critical habitat.

8.1 UPPER WILLAMETTE RIVER CHINOOK SALMON

Currently, the UWR Chinook ESU is at a high risk of extinction. Numbers of natural-origin spawners are low and long- and short-term productivity trends are negative. Five of the seven populations are at a very high risk of extinction. Primary limiting factors have been flood control and hydropower, hatcheries, harvest, habitat degradation (tributary, mainstem, and estuarine), predation, and ocean and climate conditions. Total allowable harvest rates are 12% in the ocean and 15% in freshwater fisheries.

Within the freshwater portion of the action area, the species' viability (as described by the abundance, productivity, spatial structure, and genetic diversity of its component populations)

has been limited by factors associated with the Willamette Project: flood control and hydropower operations have prevented access to historical habitat; water storage contracting has exacerbated poor habitat and altered natural water temperature patterns; and large numbers of hatchery-origin fish spawning with those of natural origin have created a risk of genetic introgression. Other threats include land use, especially the development of low elevation riparian areas for agriculture and urbanization and operations at FERC-licensed projects on the mainstem Santiam River and in the McKenzie basin. The former will continue into the future, although non-federal habitat-related actions and programs that NMFS has determined are reasonably certain to occur will minimize adverse effects. Conditions at the FERC projects are improving based on section 7 consultations in recent years.

Within the lower Columbia River and estuary (i.e., below the confluence of the Willamette), used for rearing by subyearling Chinook from this ESU, riparian and wetland functions have been reduced by Federal Columbia River Power System (FCRPS) flow management. The 2008 FCRPS RPA (NMFS 2008a) requires the implementation of habitat projects that address limiting factors (e.g., protecting and restoring riparian areas, protecting remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reducing noxious weeds). The sport reward fishery for Northern pikeminnow will continue to control this predator, and Caspian terns will be relocated from the estuary. However, predation by other colonial waterbirds such as double-crested cormorants and by pinnipeds will continue. In the coastal ocean, ongoing private activities include construction and associated marine pollution.

Under the Proposed Action, many of the significant adverse effects on the species and its critical habitat in the freshwater portion of the action area, which contributed to its current high risk of extinction, will continue without providing needed measures including effective passage, or adequate temperature control. In addition, the Proposed Action will continue the adverse effects on the functioning of PCEs that have impaired the ability of critical habitat to serve its conservation role for the species. Therefore, NMFS concludes that the proposed operation of the Willamette Project and associated hatchery mitigation program are likely to jeopardize the continued existence of this ESU and to destroy or adversely modify its designated critical habitat.

8.2 Upper Willamette River Steelhead

Currently, the UWR steelhead DPS is at a moderate risk of extinction. Numbers of natural-origin spawners are moderate and short-term trends in productivity are upward. Primary limiting factors have been flood control and hydropower, hatcheries, harvest, habitat degradation (tributary, mainstem, and estuarine), predation, and ocean and climate conditions. Ocean harvest is assumed to be zero and less than 2% of natural-origin fish are harvested in freshwater.

Limiting factors and effects of the proposed action on the species and its habitat are similar to those described above for UWR Chinook salmon. In this case, two of the four populations occupy watersheds where habitat has been significantly degraded by Willamette Project operations. The Proposed Action will continue to prevent access to some of the important areas used historically for spawning, incubation, and larval growth and development and will impair of

water quantity and quality. The Proposed Action will also continue hatchery practices that represent substantial risk to the development of self-sustaining populations. The improvements implemented under the Proposed Action will not provide needed measures including effective passage, or adequate temperature control.

When taking into account the current status of the species and its critical habitat, the degraded condition of the environmental baseline, and cumulative effects, the Proposed Action will not address the effects of the Willamette Project such that the DPS is likely to survive with an adequate potential for recovery. In addition, the Proposed Action will continue the adverse effects on the functioning of PCEs that have impaired the ability of critical habitat to serve its conservation role for the species. Therefore, NMFS concludes that the Proposed Action is likely to jeopardize the continued existence of this DPS and to destroy or adversely modify its designated critical habitat.

8.3 Lower Columbia River Steelhead, Chinook Salmon & Coho Salmon

All of the populations in these listed DPS and ESUs spawn outside the action area, but use the habitat in the lower Columbia River, from the confluence of the Willamette downstream to the estuary and plume, for rearing (for Lower Columbia River Chinook populations with subyearling migrants) and during their adult and juvenile migrations. Within the action area, the viability of these species has been limited by harvest, hatchery production, land management practices, the effects of the FCRPS, and the operations of other federally- and privately-owned hydroprojects, including water diversions and are further threatened by potential climate change and adverse ocean conditions (NMFS 2008a). With respect to the FCRPS, effects on these species are addressed by the 2008 FCRPS RPA (NMFS 2008a); many of the adverse effects of the FERC-licensed hydroprojects also have been addressed in recent consultations (Sections 3.2.3.1 through 3.2.3.3). Proposed Willamette Project flow operations could reduce the quantity and quality of rearing habitat in the lower river, estuary, and plume, including critical habitat designated for two of these species. These effects are likely to be minor because flows from the Willamette River are a relatively small proportion of those in the lower Columbia. Therefore, when taking into account the current status of the species and their critical habitat, the condition of the environmental baseline within the action area, and cumulative effects, NMFS concludes that the Proposed Action is not likely to jeopardize the continued existence of Lower Columbia River Chinook, steelhead, or coho salmon, nor adversely modify or destroy critical habitat designated for Lower Columbia River Chinook or steelhead.

8.4 Columbia River Chum Salmon

Columbia River chum salmon spawn outside the action area but use habitat in the lower Columbia River, from the confluence of the Willamette downstream to the estuary and plume for rearing and during their adult and juvenile migrations. Within the action area, the viability of the species has been limited by land management practices and the effects of the Federal Columbia River Power System (FCRPS), which have impaired water quality and quantity, forage, riparian vegetation, and space in estuarine areas used for growth and development. The species is threatened by potential climate change and adverse ocean conditions. The effects of the FCRPS are addressed by the 2008 FCRPS RPA (NMFS 2008a). Proposed Willamette Project flow

Chapter 9
Reasonable & Prudent Alternative

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9 REASONABLE & PRUDENT ALTERNATIVE

INTRODUCTION

In Section 8, NMFS concluded that the Proposed Action would jeopardize the continued existence of UWR Chinook salmon and UWR steelhead, and destroy or adversely modify their designated critical habitat. NMFS reached no jeopardy and no adverse modification conclusions for the 11 other listed salmonid species, and NLAAs for green sturgeon and southern resident killer whale. Therefore, NMFS is providing the Action Agencies with the following reasonable and prudent alternative (RPA) to avoid jeopardizing the continued existence of UWR Chinook salmon and UWR steelhead, and avoid destroying or adversely modifying their critical habitat, as required by ESA section 7(b)(3)(A).

An RPA is an action, identified during formal consultation, that can be carried out consistent with the purpose of the action, is within the scope of the action agency's legal authority, is economically and technologically feasible, and would avoid jeopardy to listed species and the destruction or adverse modification of designated critical habitats (50 CFR 402.02). The measures NMFS is providing in the RPA fit the regulatory requirements of an RPA. The measures fall into the general categories of substantive measures for fish passage, water quality, flows, water contracts, habitat, and hatcheries. There are also measures for coordination, studies, and monitoring related to the substantive measures. These measures have time frames for each action. The RPA measures are within the project purposes because fish and wildlife protection is a project purpose. The Action Agencies have legal authority to carry out these measures because the statutes that authorize the project include project purposes for fish and wildlife protection, and in some cases already include specific provisions for some of the measures.

These general categories of the measures in the RPA, fish passage, water quality, flow, water contracts, habitat, and hatcheries, are all measures in the PA that, when considered with the environmental baseline and cumulative effects and the rangewide status of UWR Chinook salmon and UWR steelhead, did not result in survival with an adequate potential for recovery for these species. In addition, they were inadequate to avoid the destruction or adverse modification of designated critical habitat. NMFS' RPA includes the measures in the PA, adds new measures, and modifies others in the PA. A general concept behind most of NMFS additional measures and modifications is to build on the studies in the PA by adding on-the-ground measures that the Action Agencies will complete to address Project effects on listed anadromous fish. Therefore, NMFS' RPA specifically lists measures that the Action Agencies will carry out after the necessary studies and designs are completed to verify feasibility. NMFS' assessment of effects regarding the RPA's avoidance of jeopardy and destruction or adverse modification of critical habitat is based on the benefits attributed to successful completion of these measures.

Structural and operational changes at Project dams and improvements in Action Agency programs that affect salmonid habitat downstream of the dams and that allow upstream and downstream fish passage are needed to address the effects of the Willamette Project, thereby increasing the viability of the affected populations and the functioning of the PCEs of their designated critical habitat. Specifically, construction and operation of new facilities for effective up- and downstream fish passage at Project dams, installation of water temperature control

(WTC) at Project dams, more normative discharge patterns downstream of these dams, mitigation of ongoing effects of the dams and continued existence and maintenance of revetments on the physical characteristics of downstream salmonid habitats, and hatchery programs more strongly focused on species conservation, are needed to address project effects on listed fish in multiple subbasins. The Action Agencies' proposed measures in the PA provide improvements to the existing system and operations, but do not adequately address project effects on listed fish and their habitat. Many of those measures lacked deadlines for beginning and completing work. This lack of certainty and specificity was one of the reasons that NMFS made the jeopardy and adverse modification of critical habitat determinations in Section 8. Another reason was that there were not enough specific on-the-ground measures to adequately address project effects and avoid jeopardy and destruction and adverse modification of critical habitat. In order to assure timely progress toward implementing critical on-the-ground actions, NMFS' RPA establishes deadlines for completing studies, structural and operational improvements at the dams and hatcheries, and for implementing habitat restoration programs. Specific projects are identified that must be completed in the short term, while other, larger projects must be completed during later years of the term of the Opinion. In the RPA, certain specific fish passage and temperature control measures will be completed by 2023, the end of the Opinion term. Additionally, significant progress will be made toward identifying future passage and temperature control measures that could be implemented after 2023 under a subsequent consultation.

A number of the RPA measures will provide benefits in the short-term, reducing each species' short-term risk of extinction, including measures to improve downstream habitat by changing flows and temperature, updating hatchery operations and facilities, improving irrigation diversions and water contracts, upgrading fish collection facilities and outplanting procedures, and conducting habitat improvement projects. These measures will immediately (during the first one-to-seven years of this Opinion) improve population viability and reduce the short-term risk of extinction. This is especially important for UWR Chinook salmon, for which the risk of extinction is "high."[1] Project operations have had a key role in degrading habitat conditions downstream, which in the North and South Santiam, South Fork McKenzie, and Middle Fork Willamette are the only areas still accessible to Chinook for spawning, incubation, and early rearing. The Action Agencies began new reservoir operations in 2000 to meet mainstem and tributary flow objectives for both listed Chinook and steelhead. These, and operations that began in 2005 at the new Water Temperature Control facility at Cougar Dam, are already able to have a positive influence on adult Chinook returns. Under the RPA, interim temperature control operations at Detroit will improve water temperatures in the North Santiam, increasing the survival of eggs, juveniles, and pre-spawning adults of both species and thus population productivity. All of these measures will reduce extinction risk in the short term as well as contributing to long-term viability.

Decision-making for all of the final actions and implementation of measures included in the RPA must comply with all applicable statutes and regulations. Among those the Action Agencies must consider are NEPA, the Clean Water Act and the Northwest Power Planning Act. In so doing, the criteria the Action Agencies will apply are whether the action is: (1) biologically feasible and

[1] The WLCTRT (McElhany et al. 2007) estimated the risk of extinction over 100 years for UWR Chinook ("high;" see Figure 3-5 in Section 3.2.1.3). The TRT did not estimate the species' short-term extinction risk.

beneficial; (2) technically feasible; and (3) cost effective. These criteria would not necessarily apply to interim decision points and to information gathering requirements. In addition, the Action Agencies' Configuration/Operation Planning (COP) study process will outline the costs of specific projects, their biological benefits, and a reasonable array of potential alternatives to achieve the desired results.

The measures in this RPA are additive to the Action Agencies' Proposed Action (USACE 2007a). That is, the two sets of measures combined create the complete RPA that NMFS will analyze. For the sake of brevity, the RPA measures provided below only include measures that are not in the PA, and PA measures that are changed in some way. In the event there are inconsistencies between the PA and RPA, this RPA will take precedence.

9.1 COORDINATION

The RPA measures in this section are based on Section 3.1 of the Supplemental BA (USACE 2007a). In that section, the Action Agencies propose to organize the WATER group, prepare a charter, and establish various subcommittees. In recent years, the USACE has informally coordinated flow management and project operation issues with other federal agencies, state agencies, local government, and other organizations, but there were no guidelines for how this coordination should take place or what would happen if technical participants could not agree. The Action Agencies proposed the WATER group to formalize this process and to ensure consistent coordination and decision-making. NMFS supports the Action Agencies' proposal, but we include it here with minor revisions to clarify the decision-making process and agency roles. This clarification is needed in the RPA because most of the actions that will be taken to avoid and minimize effects on listed salmonids and critical habitat rely on either in-season management (mainstem and tributary flows, response to emergency operations), review of RM&E studies (e.g., downstream fish passage measures) and review of engineering design alternatives (e.g., adult fish collection facilities, temperature control facilities. In order to ensure these ongoing decisions are implemented in a fashion consistent with the analysis in this Opinion, the following measures are needed:

RPA 1 Coordination

1.1 **<u>Charter of WATER</u>: By December, 2008, the Action Agencies, in coordination with the Services, other federal and state agencies with fisheries and water resource management responsibilities in the Willamette River Basin, and affected Tribes, will complete a Charter for a collaborative advisory body to be known as the Willamette Action Team for Ecosystem Restoration (WATER). Once the Charter is completed, the Action Agencies will coordinate with the WATER on operation of the Willamette Project consistent with the Charter. The WATER will be a formalized, collaborative body to advise the Action Agencies in the coordinated implementation of the environmental protection and conservation measures described in the Proposed Action, RPA, and other actions that may develop while operating the project.**

Rationale/Effect of RPA 1.1: This measure clarifies that the Action Agencies and the Services, other federal agencies, state agencies, and tribes will complete a charter for WATER by December, 2008, and will operate according to the charter. The Proposed Action had stated it would be done within one year of completion of the Supplemental BA (i.e., by June 2008), but that date has now passed.

The effect of this measure will be to improve and inform the Action Agencies' and Services' decision making, provide a forum for various points of view, share scientific and technical information, and coordinate actions by the parties. This coordination and sharing of information will ultimately reduce the time needed to address the effects of the Project on population viability and the functioning of PCEs of designated critical habitat.

1.2 **Technical Sub-Committees of WATER: The Action Agencies will establish technical coordinating committees as part of the WATER to provide review and recommendations of Action Agencies' products. Technical experts from applicable state agencies and the Tribes may participate on committees based on the subject matter of each committee and the scope of each organization's respective areas of responsibility and expertise. Other parties may participate on the subcommittees depending on the subject area and agreement by the Action Agencies and Services. The number, responsibilities, and scope of the technical committees formed will be determined by the Action Agencies and the Services through development of a charter for WATER. However, at a minimum, these will address flow management; fish passage and hatchery management; environmental coordination for construction projects; water quality/temperature control; habitat restoration; and research, monitoring, and evaluation.**

Rationale/Effect of RPA 1.2: NMFS adds this measure in place of the detailed description of each subcommittee proposed by the Action Agencies in Section 3.1 and Figure 3-1 of the Supplemental BA (USACE 2007a). The specific number, function, and membership of each subcommittee should be developed through development of the charter rather than pre-supposed in the Proposed Action. While NMFS encourages active participation by a variety of organizations and individuals on these issues, timely decisions on fish protection measures such as fish passage facilities and necessary RM&E to support those decisions need to be made by entities with fish management authority. The charter must be clear that the committees will play an advisory role only and will not replace the Action Agencies' responsibilities to carry out measures required by the Proposed Action and this RPA.

1.3 **WATER Decision-Making Process: The Action Agencies will ensure that the Charter for WATER and its technical coordinating committees describes a decision-making process that recognizes the unique role played by NMFS and USFWS in decisions related to measures covered in their respective Biological Opinions. In this process, the Action Agencies will prepare initial proposals for operations, studies, or structural changes and will seek review and comment by the applicable WATER subcommittee. Committee members, including NMFS and USFWS, will provide feedback to the Action Agencies within a maximum 60-day period, or less,**

depending on the magnitude and complexity of the proposal. The Action Agencies will then modify the proposal as they determine necessary to address committee members' comments and to meet their ESA responsibilities. NMFS or USFWS (or both, depending on the subject and what species might be affected) will review the final document and inform the Action Agencies whether they agree with it. If NMFS or USFWS disagrees with a proposal based on concerns that the proposal may adversely affect species within their respective authorities or be inconsistent with their respective Biological Opinions[2], the Action Agencies will either modify the proposal to address the Services' concerns, elevate the decision following a process described in the Charter, or seek reinitiation of consultation.

Rationale/Effect of RPA 1.3: This measure specifies that the WATER process must use this decision-making process to ensure that measures required by this Opinion are carried out effectively and in a timely manner, with adequate opportunity for review and comment. The Action Agencies retain ultimate responsibility for completing required actions. Adaptive management decisions need to be made with written supporting documentation. NMFS and USFWS will inform the Action Agencies whether they agree or disagree with the decisions, or if specific decisions are inconsistent with their respective Opinions. If the NMFS or FWS disagree, the Action Agencies must either modify decisions, seek dispute resolution, or reinitiate consultation.

1.4 **Role of Services in decision-making (agreement with Action Agencies): The Action Agencies will provide NMFS, USFWS, or both, as appropriate depending on the action and species affected, with draft documents for comment. The Action Agencies will address comments received from NMFS and USFWS when finalizing a document. If the Services do not agree with the final document, then they will elevate the issues for resolution, if appropriate.**

Rationale/Effect of RPA 1.4: This new measure is needed to clarify that the Services play a unique role during the implementation phase of measures required by their respective Opinions. Unlike many other Section 7 ESA consultations that address specific, short-term projects and that require specific mitigation measures that are used during and directly after construction, this consultation involves many measures that are not clearly defined yet and are awaiting study results and design feasibility analyses before specific decisions can be made. For instance, in the fish passage measures below (section 9.4), NMFS requires that downstream fish passage be carried out at Cougar Dam by a specific year, but until field studies are completed and design alternatives analyzed, NMFS cannot predict what sort of system or set of operations this will be. NMFS anticipates that it will be closely involved in review of all facets of these studies and analyses to ensure that decisions made are consistent with the statement and intent of this Opinion. The effect of this dispute resolution provision will be to preserve both the Action Agencies' and Services' authorities.

[2] This measure does not broaden either of the Services authority to engage in issues outside of each agency's authority, except that it does provide for both agencies to engage in issues that affect species listed by both agencies.

9.2 FLOW MANAGEMENT

The measures in this section are based on Section 3.3 of the Supplemental BA (USACE 2007a). In that section, the Action Agencies propose to do the following: 1) organize a Flow Management Committee of the WATER group; 2) develop a protocol for notification when Project operations cause deviations from flow and ramping objectives; 3) operate to make every effort to meet or exceed minimum mainstem Willamette flow objectives; 4) operate to make every effort to meet or exceed minimum tributary flow objectives; 5) operate to follow hourly and daily ramp-down rates under normal operating conditions; 6) release spill at Foster Dam during spring for downstream fish passage; and 7) develop and carry out a comprehensive RM&E program to evaluate and monitor these flow management actions.

NMFS generally supports the Action Agencies' flow management proposals, but the following measures are needed to improve the decision-making process, increase the likelihood and frequency of meeting flow and ramping rate objectives, and define agency roles. This clarification is needed in the RPA because most of the actions that will be taken in the short-term to avoid and minimize effects on listed salmonids rely on either in-season management (mainstem and tributary flows, response to emergency operations), review of RM&E studies (e.g., downstream fish passage measures) and review of engineering design alternatives (e.g., adult fish collection facilities, temperature control facilities).

RPA 2 Flow Management

2.1 **<u>WATER Flow Management Committee</u>: The USACE will establish a Flow Management (FM) Committee under WATER to advise USACE on streamflow management issues related to operation and maintenance of the Willamette Project. The USACE will take a leadership role in the administration of this committee, providing for coordination, administration costs, and meeting space. The USACE, with review by the FM Committee, will develop and implement the annual Willamette Conservation Plan,[3] and coordinate on all issues related to listed fish with the Services and with Federal and state agencies, Tribes, and entities throughout each flow management season.**

Rationale/Effect of RPA 2.1: This measure modifies a similar action described in section 3.3.3 of the Supplemental BA (USACE 2007a) by assigning responsibility for managing and funding the committee to the USACE. The role of the committee is advisory to the USACE. Coordination throughout the flow management season should maximize benefits to listed fish, consistent with authorized Project purposes and giving due consideration to the relative importance of each.

The effect of this measure will be to improve decision-making regarding flow management and ensure that the USACE will operate the Project to minimize adverse Project effects on listed fish, consistent with other authorized Project purposes.

[3] The Annual Willamette Conservation Plan is reviewed and revised each year. It describes minimum and maximum mainstem and tributary flow objectives that guide the Action Agencies' operation of the 13-dam Willamette Project, and it includes specific operational priorities for the given year.

Indirectly, this measure will help improve survival of juvenile and adult fish during migration through the mainstem Willamette and Project-affected tributaries by ensuring that timely decisions regarding Project flow releases are made and issues quickly resolved during in-season management. Likewise, this measure will help improve productivity of UWR Chinook salmon and UWR steelhead that spawn below Project dams by ensuring that local biologists are queried to provide real-time data regarding fish presence and that timely decisions are made to reduce impacts to redds once adults have spawned.

2.2 **Protocol for Notification of Deviations: The Action Agencies will notify the Services when turbine units, regulating outlets, and spillway gates malfunction or are placed out of service for an emergency which results in an unscheduled outage that may have an impact on ESA-listed fish species. The Action Agencies will follow the notification protocol described in RPA measure 4.3 (Willamette Fish Operations Plan) below.**

Rationale/Effect of RPA 2.2: This measure is described in RPA measure 4.3 below.

2.3 **Minimum Mainstem Flow Objectives: The USACE will operate the system in a manner to meet or exceed minimum mainstem flow objectives listed in Table 9.2-1 as measured at Salem and Albany, Oregon, following the framework described in Appendix D and in collaboration with the Services and other entities as provided in RPA measures 1 and 2.1. Based on RM&E results (RPA measure 9 in section 9.9 below) and operational experience, and with the approval of the Services and review by the FM Committee, the USACE will amend mainstem flow objectives (Table 9.2-1) in its Annual Willamette Conservation Plan.**

Rationale/Effect of RPA 2.3: This measure is based on a similar action described in section 3.3.5 of the Supplemental BA (USACE 2007a). The minimum mainstem flow objectives are the same as in the Proposed Action, and NMFS adopts Appendix D, which recognizes that these flow objectives will likely not be met in water years that are not "adequate" or "abundant" as defined in Appendix D. The primary difference from the Proposed Action measure is that this measure requires approval by the Services of any changes in Table 9.2-1 flow objectives, while the Proposed Action simply required the Action Agencies to consider recommendations from NMFS and other FM Committee members.

The effect of this measure is that it will better ensure adequate flows for UWR Chinook salmon and UWR steelhead that migrate and rear in the mainstem Willamette River than provided by the Proposed Action. In the Mainstem Willamette Effects section 5.10, NMFS found that the proposed mainstem flow objectives were sufficient based on existing data. These flow objectives would be expected to aid downstream migration of juvenile steelhead by reducing the likelihood of disease outbreaks based on flow and water temperature relationships. Additionally, minimum flow objectives during summer months would provide water quality benefits to rearing juvenile Chinook and steelhead

and upstream migrating adult Chinook. However, NMFS noted that additional data are needed to better define fish flow needs in the mainstem Willamette. This measure gives the Services approval authority over any proposed changes in the flow objectives. In the event that the RM&E studies required by measure 9 in section 9.9 indicate that different flow objectives should be established, the Action Agencies and NMFS would work together to identify flow objectives that protect ESA-listed fish species and their critical habitats.

Table 9.2-1 Mainstem Willamette Flow Objectives for "Adequate" & "Abundant" Years.[1]

TIME PERIOD	7-DAY MOVING AVERAGE [2] MINIMUM FLOW AT SALEM (CFS) USGS 14191000[4]	INSTANTANEOUS MINIMUM FLOW AT SALEM (CFS) USGS 14191000	MINIMUM FLOW AT ALBANY (CFS) [3] USGS 14174000[5]
April 1 - 30	17,800	14,300	---
May 1 - 31	15,000	12,000	---
June 1 - 15	13,000	10,500	4,500 [3]
June 16 - 30	8,700	7,000	4,500 [3]
July 1 - 31	---	6,000 [3]	4,500 [3]
August 1 - 15	---	6,000 [3]	5,000 [3]
August 16 - 31	---	6,500 [3]	5,000 [3]
September 1 - 30	---	7,000 [3]	5,000 [3]
October 1 - 31	---	7,000	5,000

[1] Appendix D defines "Adequate" and "Abundant" water years, and also describes how flow objectives can be decreased in "Deficit" water years.
[2] An average of the mean daily flows in cubic feet per second (cfs) observed over the prior 7-day period.
[3] Congressionally authorized minimum flows (House Document 531). September flows were extended into October.
[4] USGS gage 14191000 Willamette River at Salem, OR
[5] USGS gage 14174000 Willamette River at Albany, OR

2.4 **<u>Tributary Flow Objectives –Project Release Minimums:</u> The USACE will operate Willamette project dams as described in this subsection to meet or exceed minimum tributary flow objectives listed in Table 9.2-2 to ensure adult fish access to existing spawning habitat below USACE dams, protect eggs deposited during spawning, and provide juvenile rearing and adult holding habitat for listed salmonids and other fishes within system constraints described in Appendix D. If, during annual operations, the system of Willamette Projects is unable to meet both mainstem and tributary flow objectives, the Action Agencies will notify NMFS and will coordinate through WATER to determine a suitable course of action to protect priority fish habitat needs. Consistent with Appendix D, USACE will operate to meet interim draft limits.**

Rationale/Effect of RPA 2.4: This measure is based on a similar action described in section 3.3.6 of the Supplemental BA (USACE 2007a). The minimum and maximum tributary flow objectives are the same as in the Proposed Action. NMFS also recognizes that it will not be possible to meet these flow objectives under all hydrologic conditions.

However, NMFS does not agree with the Action Agencies that other project purposes (i.e. recreation), as expressed by the proposed drafting priority (Table 2-6, in Chapter 2), should take priority over meeting tributary and mainstem flow objectives. For this reason, we include RPA measure 2.4.4 to identify opportunities to manage available water resources in a manner that improves the likelihood of providing flows known to be protective of salmon and steelhead and their critical habitats (see Section 5.5.2.1). The primary difference from the Proposed Action measure is that this measure emphasizes the fisheries objectives for these flows. This measure also requires the Action Agencies to notify NMFS when they are unable to meet both mainstem and tributary flow objectives, and emphasizes that NMFS will provide guidance on fish protection priorities.

The effect of this measure is that it will better ensure adequate flows for UWR Chinook salmon and UWR steelhead that migrate and rear in Project-affected tributaries (Middle Fork Willamette, McKenzie, South Santiam, and North Santiam subbasins) than provided by the Proposed Action. In the various Effects sections for these subbasins (sections 5.2 through 5.6), NMFS found that the proposed tributary flow objectives were sufficient based on existing data. However, NMFS noted that flows released from Project dams for fish protection purposes should be protected throughout the tributary reaches where such flows are needed for spawning, rearing, holding or migration. The Proposed Action limits the Action Agencies' obligation to flow rates at the lowermost Project dam on each tributary, but does not establish flow requirements for reaches downstream from the dams to the mouth of the tributaries because the Action Agencies do not have enforcement authority over water diversions. NMFS adds sub-measures 2.4.1 through 2.4.4 below to address this issue for the lower tributary reaches. Studies required by RPA measure 2.10 below will guide decisions to modify these flow objectives to better protect ESA-listed fish species.

Table 9.2-2 Minimum & Maximum Tributary Flow Objectives below Willamette Dams (USACE 2007a; Donner 2008)

DAM	PERIOD	PRIMARY USE	MINIMUM FLOW (CFS) [1]	PERCENT OF TIME FLOW IS EQUALED OR EXCEEDED[4]	MAXIMUM FLOW (CFS) [2]	PERCENT OF TIME FLOW IS EQUALED OR EXCEEDED[4]
Hills Creek	Sep 1 - Jan 31	Migration & rearing	400	99.9		
	Feb 1 - Aug 31	Rearing	400	99.9		
Fall Creek	Sep 1 - Oct 15	Chinook spawning	200	95	400 through Sep 30, when possible	25
	Oct 16 - Jan 31	Chinook incubation	50 [3]	99.9		
	Feb 1 - Mar 31	Rearing	50	99.9		
	Apr 1 - May 31	Rearing	80	99.9		
	Jun 1 - Jun 30	Rearing/adult migration	80	99.9		
	Jul 1 - Aug 31	Rearing	80	95		
Dexter	Sep 1 - Oct 15	Chinook spawning	1200	99.9	3,500 through Sep 30, when possible	10

DAM	PERIOD	PRIMARY USE	MINIMUM FLOW (CFS) [1]	PERCENT OF TIME FLOW IS EQUALED OR EXCEEDED[4]	MAXIMUM FLOW (CFS) [2]	PERCENT OF TIME FLOW IS EQUALED OR EXCEEDED[4]
	Oct 16 - Jan 31	Chinook incubation	1200 [3]	99.9		
	Feb 1 - June 30	Rearing	1200	99.9		
	Jul 1 - Aug 31	Rearing	1200	99.9		
Big Cliff	Sep 1 - Oct 15	Chinook spawning	1500	95	3,000 through Sep 30, when possible	5
	Oct 16 - Jan 31	Chinook incubation	1200 [3]	98		
	Feb 1 - Mar 15	Rearing/adult migration	1000	99.9		
	Mar 16 - May	Steelhead spawning	1500	99.9	3,000	25
	Jun 1 – Jul 15	Steelhead incubation	1200 [3]	99.9		
	Jul 16 - Aug 31	Rearing	1000	99.9		
Foster	Sep 1 - Oct 15	Chinook spawning	1500	75	3,000 through Sep 30, when possible	1
	Oct 16 - Jan 31	Chinook incubation	1100 [3]	80		
	Feb 1 - Mar 15	Rearing	800	95		
	Mar 16 - May	Steelhead spawning	1500	80	3,000	30
	May 16 - Jun 30	Steelhead incubation	1100 [3]	95		
	Jul 1 - Aug 31	Rearing	800	99		
Blue River	Sep 1 - Oct 15	Chinook spawning	50	99.9		
	Oct 16 - Jan 31	Chinook incubation	50	99.9		
	Feb 1 - Aug 31	Rearing	50	99.9		
Cougar	Sep 1 - Oct 15	Chinook spawning	300	99.9	580 through Sep 30, when possible	60
	Oct 16 - Jan 31	Chinook incubation	300	99.9		
	Feb 1 - May 31	Rearing	300	99.9		
	Jun 1 - Jun 30	Rearing/adult migration	400	99.9		
	Jul 1 - Jul 31	Rearing	300	99.9		
	Aug 1 - Aug 31	Rearing	300	99.9		

[1] When a reservoir is at or below minimum conservation pool elevation, the minimum outflow will equal inflow or the congressionally authorized minimum flows, whichever is higher.
[2] Maximum flows are intended to minimize the potential for spawning to occur in stream areas that might subsequently be dewatered at the specified minimum flow during incubation.
[3] The USACE will attempt to avoid prolonged releases in excess of the recommended maximum spawning season discharge to avoid spawning in areas that would require high incubation flows that would be difficult to achieve and maintain throughout the incubation period. When maximum flow objectives are exceeded for a period of 72 hours or longer, the WATER Flow Management Committee will review available monitoring information (e.g., regarding redd deposition in relation to flow rates), projected runoff, and reservoir storage, and will formulate a recommendation for an appropriate and sustainable incubation flow rate prior to the initiation of the subsequent incubation period.
[4] Flow duration estimates are based on HEC-ResSim model output data for the Biop operation. Period of Record of model data is Water Years 1936-2004.

In order to improve the likelihood of meeting tributary minimum flow objectives, the Action Agencies will complete the following actions:

2.4.1 **Lower River Gages: The USACE will establish and operate gage stations at locations near the mouths of the tributaries listed below in this paragraph, by July 1, 2009, and will operate the stations through the term of this Opinion to develop relationships between release flows and gage flows. The plan will initially assess the adequacy of existing gages, if any, and need for new gages where none exist, in the lower reaches of the**

- **North Santiam River**
- **South Santiam River**
- **McKenzie River**
- **Middle Fork Willamette River below Dexter**
- **Middle Fork Willamette River below Hills Creek, and**
- **Fall Creek**

The need for each gage will be determined based on fish use of lower river habitat and number of consumptive water diversions in each tributary. The USACE will complete a plan identifying the number and specific location of existing and new gages that are needed, in coordination with and review by the Services,[4] by January 1, 2009. At a minimum, river stage and water temperature will be measured at those sites where gages are needed. Stage-flow relationships will be developed and maintained for accuracy. Unless good cause is given, USACE will work with U.S. Geological Survey to ensure that these stations will be part of the USGS' water data program and maintained in USGS' Real-Time data system.

Rationale/Effect of RPA 2.4.1: This measure is not in the Proposed Action. NMFS includes it here as a first step in determining whether flows released from Project dams are available for fish habitat needs in downstream tributary reaches. Presently, minimum flow targets are set at the dam, but biologically, they are needed throughout the reach. For example, if Project release flows in a given tributary are only needed for adult fish spawning in the first mile below the dam, then it is likely that those release flows are available throughout that one mile reach. On the other hand, if Project release flows are intended to provide juvenile rearing habitat in the tributary from the dam all the way downstream to its confluence with the Willamette River, then it is possible that existing, proposed, and future consumptive water users may divert these flows, resulting in inadequate habitat for juvenile rearing (or other fish habitat needs, depending on the tributary, specific reach, and species and life stages present).

NMFS acknowledges that the Action Agencies are not authorized to enforce State water rights. However, if data obtained from stream gages indicates that flows

[4] See RPA 1.3 & 1.4 for elaboration of decision making process.

are lower than needed in specific tributary reaches, then the Action Agencies could modify flow releases at dams in those tributaries to compensate consumptive water withdrawals. (See RPA 2.4.3 and 2.4.4 for this subsequent action).

The effect of this measure is that the lower river gages will allow the Action Agencies to correlate dam releases to downstream flows, such that in the future, dam releases could be adjusted, if necessary, to ensure sufficient flows are provided to the reaches where they are needed for fish spawning, rearing, passage, and holding.

2.4.2 **Tributary Instream Flow Studies: In coordination with the Services, the Action Agencies will develop a detailed study plan by December 2008 to conduct instream flow studies in 2009 and 2010. The primary goal of these studies will be to identify the relationships between river flow rates and habitat conditions for adult passage, holding, and spawning and juvenile rearing in the following tributaries: N. Santiam, S. Santiam, Fall Creek, Middle Fork Willamette, SF McKenzie, and McKenzie (listed in priority order).**

Rationale/Effect of RPA 2.4.2: As noted above in RPA 2.4 and 2.4.1, existing tributary minimum flow objectives are based on the best available data, but that in most of the tributaries, flow requirements are based on protecting a single life stage in a specific reach, such as steelhead spawning in a few miles below a Project dam. Incomplete information exists regarding fish flow needs for other life history stages when Chinook salmon and steelhead spend time in the tributaries, such as adult holding, juvenile rearing, and adult and juvenile migration. These studies need to take place in the first few years of the Opinion's term to determine fish flow needs for all life stages that use the tributaries. This information can then be used in Project operational modeling, as described in RPA 2.4.3 below, to determine if storage water is available in Project reservoirs to release needed fish flows, or if not, how reservoir operations could be optimized to best protect salmon and steelhead. Additionally, the study information would be used with gage data from RPA 2.4.1 to determine if Project release flow objectives are adequate to meet fish flow needs in lower tributary reaches.

The effect of this measure, when considered together with RPA measures 2.4.1, 2.4.3, and 2.4.4, will be to improve flow management for fish habitat needs based on current scientific analyses.

2.4.3 **Revise Minimum Flow Objectives Table: Following completion of the studies specified in RPA measure 2.4.2 above, the USACE, in coordination with the Services, will determine if the minimum and maximum flow objectives in Table 9.2-2 are appropriate. If the studies suggest that fish protection goals can be better met with different flow levels than those specified in Table 9.2-2, then USACE, consistent with 2.4.4 below, will recommend any changes in**

flow objectives in applicable tributaries to improve benefits to listed fish while continuing to meet Project purposes. The Services will inform the USACE whether they agree[5] with the modified flow objectives. By January 2011, the USACE will revise its annual water management plan to include the revised flow objectives indicated by studies in RPA measure 2.4.2, provided these flows are acceptable to the Services and that the flows can be released from Project reservoirs within existing system constraints. By January 2011, the USACE will use these flow objectives in operating the Project to the extent possible.

Rationale/Effect of RPA 2.4.3: This measure is the logical progression from RPA measures 2.4.1 and 2.4.2, by using information collected from stream gauging and instream flow studies to revise Table 9.2-2 and the annual water management plan. NMFS recognizes, however, that the flow studies may indicate the need for flow levels that could drain reservoirs and create conflicts with other Project purposes and subsequent instream water needs. For this reason, NMFS does not expect that the Action Agencies will be able to carry out preferred fish flows throughout the basin by 2011. Instead, NMFS intends that this measure will require the Action Agencies to develop a revised plan that identifies fish flow objectives, while recognizing that these flows may not be met at all times in all hydrologic conditions.

The effect of this measure will be to provide improved flows by providing guidance for flow management for fish habitat needs.

2.4.4 **Modify Project Operations: Following completion of the studies specified in RPA measure 2.4.2 above and determination of revised minimum flow objectives as described in RPA measure 2.4.3 above, the USACE will complete system operational modeling and NEPA analyses, if appropriate, including consideration of all project purposes, to identify modified project operations that optimize dam operations to best meet tributary and mainstem minimum flows needed to protect fish. The USACE will conduct these analyses as high-priority element of the COP (RPA measure 4.13 below). The USACE will carry out alternatives deemed feasible, as selected by the COP analysis, by January 2012.**

Rationale/Effect of RPA 2.4.4: This measure completes the studies and management plan revisions that are required by RPA measures 2.4.1, 2.4.2, and 2.4.3. These analyses will be a high priority in the COP because the information is needed to ensure that existing flow objectives are providing the expected fish benefits and, if needed, to identify alternative operations that could more effectively achieve the same benefits. The cost of the outcomes of the analyses should not require large capital investments. The purpose of this measure is to direct the USACE to complete evaluations, such as system operational modeling

[5] See RPA 1.3 & 1.4 for elaboration of decision making process.

and NEPA analyses, if necessary, to determine how to best meet revised tributary and mainstem flow objectives for fish, consistent with authorized Project purposes, and to revise system operations accordingly. By allowing an optimization routine to operate the system without arbitrary drafting priorities (see Table 2-6, in Chapter 2), the flow objectives would be met more frequently.

The effect of this analysis is to ensure that project operations are designed to manage available water resources in a manner that best protects anadromous fish and their critical habitats. This measure may require the completion of a NEPA analysis.

2.5 **<u>Tributary Flows –Project Release Maximums:</u> During winter steelhead and spring Chinook salmon spawning seasons, the USACE will maintain tributary flows below the specified maximum flow objectives listed in Table 9.2-2 to the extent practical when the reservoirs are below their respective rule curves. The USACE will notify the Services when maximum flow rates are exceeded according to the protocol described in measure 2.2 above.**

Rationale/Effect of RPA 2.5: This measure is similar to a related measure in section 3.3.6 of the Supplemental BA (USACE 2007a). The only difference is that this measure makes clear that the USACE will notify the Services when maximum flow objectives are exceeded. This notification is necessary to provide NMFS the opportunity to conduct a site evaluation to assess whether the high flows are causing adverse effects to listed fish and if so, to propose emergency measures to minimize these effects.

The effect of this measure is to avoid high tributary flows during spawning seasons to prevent fish from spawning at relatively high channel elevations that would likely be dewatered later in the season when flows drop. This measure will reduce the likelihood of redd desiccation and improve egg-to-fry survival.

2.6 **<u>Ramping Rates:</u> When project outflows are less than those in Table 9.2-3, the USACE will restrict down-ramping (the rate at which outflows are decreased) to the hourly and daily rates listed in Table 9.2-4 to minimize stranding of juvenile fish and aquatic invertebrates and desiccation of redds. NMFS' goal is for down-ramping rates not to exceed 0.1 ft/hour during nighttime hours and 0.2 ft/hour during daytime hours. Table 9.2-4 shows the increment of flow estimated to achieve a 0.1 ft/hour nighttime and 0.2 ft/hour daytime rampdown rates for a range of outflow rates.**

2.6.1 **When system operations or equipment limits prevent USACE from meeting rampdown rates at all projects, USACE will place priority on achieving ramping rates at those projects marked in Table 9.2-4 as high priority for fish protection.**

2.6.2 **The USACE will identify mechanical, operational, or equipment modifications needed to achieve these ramping rates. The Action Agencies**

will evaluate structural modifications in the COP[6] study, where indicated, to improve their ability to meet ramping rates.

2.6.3 **During active flood damage reduction operations, the USACE may deviate from the ramping rates in Table 9.2-4. However, the USACE will comply again with these ramping rates as soon as the flood risk has abated. The USACE must follow the protocol for deviations from Table 9.2-4 described in RPA measures 2.2 and 4.3.**

2.6.4 **As noted in RPA measure 2.10 below, the Action Agencies will conduct research, monitoring and evaluation of ramping rate restrictions to determine if the Table 9.2-4 ramping rates are effectively protecting fish and macroinvertebrates from stranding and redds from dewatering. Additionally, these studies will assess the effect of higher ramping rates that are presently permitted at flows greater than those in Table 9.2-3, to determine if these higher ramping rates are causing harm to ESA-listed fish or the critical habitat on which they depend. The Action Agencies will recommend appropriate changes to applicable ramping rates in Table 9.2-4 if indicated by results of the studies and consistent with authorized Project purposes. The Services will inform the Action Agencies whether they agree[7] with the modified ramping rates. The Action Agencies will implement modified ramping rates as soon as studies are completed, but no later than January 2011.**

Table 9.2-3 Project outflow rates: below these rates, down-ramping limits in Table 9.2-4 apply.

PROJECT	PROJECT OUTFLOW (CFS)
Hills Creek	1500
Dexter	3000
Fall Creek	700
Dorena	1000
Cottage Grove	800
Cougar	1200
Blue River	700
Fern Ridge	300
Foster	2000
Detroit	2000

[6] (C)onfigurations (O)peration (P)lan is Action Agencies' study and feasibility process described in section 9.4.
[7] See RPA 1.3 & 1.4 for elaboration of decision making process.

Table 9.2-4 Maximum Ramping Rates During Flow Level Changes below Upper Willamette Basin Dams (cfs)

Nighttime Rampdown Rates to Achieve 0.1 ft/hour [1, 2, 4, 5, 6]

HCR[5]		LOP[5]		FAL[5]		DOR		COT		CGR[5]		BLU[5]		FRN		FOS[5]		DET[5]	
Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change
400		1200		50				50		400		50		30		800		1000	
600	60 [3]	1500	125	100	20 [3]	100		300	30 [3]	500	80 [3]	250	30 [3]	80	20 [3]	900	100	1200	100
1000	75 [3]	2000	145	300	40 [3]	500	50 [3]	500	40 [3]	1200	100 [3]	500	50 [3]	150	30 [3]	1900	150	1500	110
1500	90 [3]	2500	150	500	50	1000	60 [3]	800	50	2400	150	700	60 [3]	300	40	2000	155	2000	130
1700	100	3000	170	700	60	3700	100					2300	100	1000	50				

Highlighted flows are higher than the minimum flows needed to protect ESA species, but are included to represent the lowest flow rate at which 0.1 ft/hr ramp rate is currently possible at these dams.

Daytime Rampdown Rates to Achieve 0.2 ft/hour [1, 2, 4, 5, 6]

HCR[5]		LOP[5]		FAL[5]		DOR		COT		CGR[5]		BLU[5]		FRN		FOS[5]		DET[5]	
Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change
400		1200		50				50		400		50		30		800		1000	
600	120	1500	250	100	40 [3]	100		300	60	500	160	250	60 [3]	80	40	900	200	1200	200
1000	150	2000	290	300	80	500	100	500	80	1200	200	500	100	150	60	1900	300	1500	220
1500	180	2500	300	500	100	1000	120	800	100			700	120	300	80	2000	310	2000	260
		3000	340	700	120									1000	100				

[1] Avoid a flow volume reduction of more than 50% per hour or the lesser of 1 foot or 50% per 24 hours. Ramping listed are decrements in release that approximately yield the resulting change in flow of 0.1 foot/hour or 0.2 foot/hour.
[2] Operations prevent USACE from meeting rampdown rates at all projects, USACE will place priority on achieving ramp rates at these projects noted as high priority for fish protection.
[3] USACE cannot achieve ramping rates at low flows due to adjustment limits of existing equipment.
[4] NMFS prefers using 0.1 ft/hour during all hours from January 1 through March 31 because mostly fry-aged fish are present then and are less able to avoid ramping effects.
[5] High priority because of the presence of ESA listed salmon and steelhead. Rates listed are for reservoir operation other than when reducing project outflow to manage for downstream flood damage reduction.
[6] Change in flow at flows higher than those listed are less critical for protecting ESA species because of proportionally smaller flow volume change.

Rationale/Effect of RPA 2.6: The objective of this measure is to minimize project effects of entrapment and stranding of juvenile salmon and steelhead in Project-affected tributaries, and to minimize the adverse effects of Project-caused discharge fluctuations on stream biota. Unregulated rivers rarely have drops in stage in excess of two inches per hour (except during floods) whereas regulated rivers can have greater and more frequent stage changes. Thus, aquatic life is not well adapted to stage drops in excess of one or two inches per hour. Fish stranding is one of the greatest negative impacts of excessive stage change. The incidence of stranding is affected by fish size, species, time of day, substrate type, channel contour, magnitude of flow change, and rate of flow change (Hunter 1992). Redd dewatering, reduced invertebrate productivity, fish emigration, and exclusion from spawning habitat can also occur. These are all adverse effects to critical habitat as well as to population numbers.

Measure 2.6.1 recognizes that equipment limits at some of the dams prevents the USACE from making fine adjustments to reservoir discharge, particularly at very low flows. This limits their ability to guarantee that they will meet ramping rate limits specified in Table 9.2-4 at all times. Despite these restrictions, the Action Agencies will to make every effort to meet the Table 9.2-4 ramping rates within existing equipment restrictions, as stated in the Proposed Action.

NMFS includes Measure 2.6.2 to require the Action Agencies to identify modifications that could be made to existing equipment and operations to enable them to meet Table 9.2-4 ramping rates at low flows. The list of modifications should be evaluated in the COP study to identify priorities for making such changes and to seek funding for this work.

Measure 2.6.3 is necessary because during high flow periods, the risk of floods increases, and the Action Agencies need more flexibility to quickly modify reservoir discharges to minimize flood risk. This extra flexibility will not harm UWR Chinook salmon and UWR steelhead because down-ramping at high flows is less likely to cause fish to strand and redds to be dewatered than downramping at lower flows. This reduced impact results from the general relationship that at high flows, large decreases in flows can result in relatively small changes in water depth, while at low flows, a change in flow can result in relatively large changes in water depth, increasing the risk of fish stranding. During flood damage reduction operations, the USACE will attempt to meet the Table 9.2-4 ramp rates, but will not be required to meet these rates.

Measure 2.6.4 references flow-related RM&E actions that are necessary as part of the RPA and Proposed Action. Project-specific ramping rate studies have not been done at Willamette Project dams, and the extent of stranding over a range of ramping rates has not been determined. These RM&Es are needed to assess whether the Table 9.2-4 ramping rates are effectively preventing fish stranding and other harm to stream biota, as well as to determine if assumptions regarding reduced risk at higher flow levels and during flood operations are valid. This

measure includes a process that the Action Agencies will use to modify ramping rates and flows at which they apply, if indicated by study results.

The effect of measure 2.6 and its subcategories, 2.6.1 through 2.6.4 is that these measures will minimize entrapment and stranding of UWR Chinook salmon and UWR steelhead juvenile fish and dewatering of their redds in Project-affected tributaries and will minimize the adverse effects of Project-caused discharge fluctuations on stream biota and critical habitat. Actions will be taken to correct existing equipment that prevents the Action Agencies from meeting Table 9.2-4 ramping rates at very low flows, and studies will evaluate the effectiveness of these ramping rates and may identify revised rates that will further reduce fish entrapment and stranding. Structural modifications and changes to ramping rates will be considered and carried out where feasible and necessary to minimize adverse effects on ESA-listed fish.

2.7 **Environmental Flow[8]/Pulse Flow Components: The Action Agencies will work through the WATER Flow Management Committee and with the Services, and other aquatic scientists with expertise in Willamette basin fish ecology and fluvial geomorphology, and stakeholders, to identify environmental flow improvement opportunities for the mainstem Willamette River and the lower reaches of tributaries with USACE dams. The Action Agencies will design, test, and carry out modifications to flow releases from USACE dams to improve channel morphology in a manner that would create and sustain new, and improve existing, fish habitat through changes in project operations, while still addressing other authorized Project purposes. For each tributary, the process will begin by identifying fluvial morphology components[9] important to ESA-listed salmonids and other biota that are currently underrepresented in the watershed. Following identification of these morphological conditions, the Action Agencies will examine the potential for improving these conditions through modification of project operations, as the Sustainable Rivers Project has done for the Middle Fork Willamette River in an effort summarized by Gregory et al. (2007). The Action Agencies will identify weak or missing morphological characteristics and, where feasible, will incorporate remedies to these conditions into one or more flow modification proposals. The Action Agencies will then submit proposals to the Flow Management Committee of WATER, which will recommend adjustments, if appropriate. The Services will inform the Action Agencies if they agree with the proposals. The Action Agencies will then carry out these flow modification proposals, initially as pilot studies and then, if determined feasible, as part of its regular water management operations. The Action Agencies will monitor the effectiveness of each environmental flow operation at achieving specific ecological objectives beneficial to ESA-listed**

[8] "Environmental flows" are used in this context to refer to a full range of pulses or high flows that accomplish various fish habitat maintenance and creation through mechanisms such as sediment distribution, channel forming processes, overbank flows, maintaining access to side or off-channel habitat.

[9] Such components may include appropriate seasons, magnitudes, durations, or rates of change in specific components of the annual hydrograph, including fall transition flows, small fall pulses in flow, winter bankfull flow pulses, small or larger floods above bankfull river levels, spring pulse flows, spring-to-summer transitions in flow, and summer baseflows.

salmonids and/or other aquatic biota. The Action Agencies will complete appropriate NEPA evaluation for alternatives being considered

Flow changes that may result from this measure could fall into one of three implementation types: (1) flow volume and timing adjustments that are within the operational flexibility of the USACE under current project authorizations and water control manuals; (2) larger scale adjustments that may fall within current operational flexibility and authority but whose implementation requires detailed evaluation of tradeoffs; and (3) major changes in operation which are clearly outside of the USACE's operational discretion and would require a thorough feasibility evaluation and possible reauthorization action. The USACE will begin implementing proposals for Type 1 environmental flow modifications on the lower Middle Fork Willamette, below Dexter Dam, in FY 2009, and explore with the Services and the Flow Management Committee of WATER any needs and opportunities to implement Type 2 or 3 flow modifications there in subsequent years. The Action Agencies will develop and carry out proposals for environmental flow modifications below other USACE dams in the Willamette Basin during the term of this Biological Opinion, with priorities among rivers identified by the Flow Management Committee. Within this period, a full effort will be made to optimize USACE management of flows in the tributaries and mainstem so as to achieve improved fish habitat benefits that are not incompatible with other purposes of the dams.

Rationale/Effect of RPA 2.7: Natural patterns of variation in flow exert significant influence on the habitat and ecology of UWR Chinook, UWR steelhead, and other aquatic organisms native to the Willamette Basin. Flow alteration by the system of USACE dams in the Willamette Basin has contributed to profound changes in the freshwater habitat of UWR Chinook and UWR steelhead. Requirements elsewhere in this Biological Opinion for seasonal minimums and maximums in flow, and for limits on down-ramp rates, do not fully address historical changes to natural patterns of variation in flow or to channel forming flows that may at present constrain the abundance and productivity of these ESA-listed anadromous fish.

The effect of this measure is to initially make minor improvements to existing spawning and juvenile rearing habitat downstream of Dexter Dam in the Middle Fork Willamette and below Dorena and Cottage Grove in the Coast Fork Willamette River. As the Action Agencies begin to release Type 1 flow modifications in other Project-affected subbasins, there will also be minor improvements to existing spawning and juvenile rearing habitat due to increased flushing of sediments, cleaning out small particles and moving new gravels into usable habitat. Over the next 15 years, Type 2 and possibly Type 3 flow modifications that will be carried out in the Middle Fork Willamette and at Project dams in other subbasins will improve or create and sustain new juvenile rearing habitat in complex habitat, side channels, or other morphological features. These actions will increase available rearing habitat and make existing spawning and rearing habitat below Project dams more suitable, resulting in increased productivity and abundance. Adverse effects on critical habitat in reaches below dams will be reduced because this measure

will improve existing rearing and spawning habitat and may create and maintain new rearing habitat.

2.8 **Foster Spring Spill: The USACE will continue to spill at Foster Dam between 0.5 and 1.5 feet of water (approximately 92 to 238 cfs), depending upon inflow and forebay elevation fluctuations, over the spillway fish weir[10]. This operation will occur from 0600 through 2100 hours daily during the primary fish passage season, April 15 through May 15. The Action Agencies will evaluate the effectiveness of this operation on downstream fish passage as part of RM&E (RPA measure 2.10) and COP studies (RPA measure 4.13). Based on the results of these studies, the Action Agencies will recommend modifications to this spill operation or new downstream fish passage facilities or operations. If modified operations are warranted and can be carried out within existing physical and operational constraints, the Action Agencies will begin to carry out these operations consistent with RPA measure 4.8, Interim Downstream Fish Passage. If more extensive modifications are needed, the Action Agencies will follow the process described in the COP study, RPA measure 4.13.**

Rationale/Effect of RPA 2.8: This measure would continue an existing spill program that provides better downstream juvenile steelhead passage survival than turbine passage at Foster Dam (see South Santiam Baseline section 4.5.3.1). Although based on a similar action described in section 3.3.8 of the Supplemental BA (USACE 2007a), NMFS includes a requirement that this measure be evaluated as part of the RM&E (RPA measure 2.10) and COP studies (RPA measure 4.13), and that the Action Agencies will modify this measure if indicated by study results.

The effect of this spill operation will be improved survival of juvenile steelhead, and likely Chinook salmon, emigrating from above Foster Dam as a result of the outplanting program.

2.9 **Protecting Stored Water Released for Fish: In coordination with the OWRD and ODFW, the Action Agencies will facilitate conversion of stored water to an instream flow water right. Oregon adopted minimum perennial streamflows for Willamette tributaries in Oregon's Willamette Basin Program (Table 1 in ORS 690-502). After being converted to water rights under Oregon law, OWRD can protect the minimum perennial stream flows from illegal diversion. The State of Oregon is solely responsible for administering and enforcing state water rights.**

Additionally, the Action Agencies will identify stored water in addition to the minimum perennial streamflows that could be allocated from reservoirs to enhance salmon and steelhead survival. The Action Agencies will proceed with necessary actions to allocate and protect water for this purpose. In particular, USACE and

[10] To provide a measure of downstream fish passage, Foster dam employs an overflow weir immediately upstream of one tainter gate (which is raised, out of service, when the fish weir is employed). This fish weir provides a surface oriented flow that better attracts and conveys fish than turbine flow.

Reclamation will coordinate with OWRD on several tasks to accomplish this measure: 1) identify current water storage at USACE reservoirs that could be allocated to instream flow for ESA listed fish; 2) determine how to legally transfer flow for instream purposes; and 3) proceed with the necessary analyses to implement the agreed upon transfers. The tasks necessary to accomplish this action may require approval from Congress. This effort will begin immediately. By the end of 2009, the Action Agencies will have coordinated with all appropriate agencies and determined the path forward in order to accomplish this action.

Rationale/Effect of RPA 2.9: Water use and development in the Willamette basin are expected to continue to grow, making it very important to preserve adequate water for fish, particularly in the tributaries. Although the Action Agencies have agreed to release minimum flows from Project dams to support fish life in tributary reaches, they cannot guarantee that these flows will be maintained throughout the reach because the State (OWRD), not the Action Agencies, has enforcement authority over water rights. Current Oregon water law allows holders of natural flow water rights in the Willamette basin to divert stored water released from Project dams when this water is not obligated by existing Reclamation contracts. Thus, even though the Action Agencies intend for some of the stored water that is released to provide fish benefits, OWRD is not authorized to protect these flows from diversion by water users because this water is not currently obligated by a contract. In early 2008, NMFS participated in staff-level meetings with OWRD, Reclamation, BPA, and USACE to identify available mechanisms for protecting these minimum flow releases for fish purposes. As a result of these meetings, the Action Agencies agreed to investigate and carry out steps to achieve this purpose of protecting a certain amount of stream flows for fish. The exact steps that the Action Agencies will take have yet to be determined, but they must first request from OWRD a transfer of portions of the existing irrigation storage water rights to another use, such as multi-purpose or fish protection.

The effect of this measure is that the flows released from Project dams for fish protection purposes will remain instream and provide intended biological benefits. Although the Action Agencies cannot guarantee what action the State of Oregon may take, this measure requires the Action Agencies to take steps within their authorities to protect these flows.

2.10 **Flow Related Research, Monitoring and Evaluation: As part of the RM&E plan described in RPA measure 9 below, the Action Agencies will plan and carry out studies and monitoring of mainstem and tributary flow rates and Project ramping rate restrictions necessary to protect fish and aquatic habitat, as well as other evaluations required by measures in this section. The flow and ramping rate studies will be considered high priority and field studies should begin in 2009, with initial results available to inform modified flows and ramping rates by January 2011.**

Rationale/Effect of RPA 2.10: This measure is needed to evaluate the effectiveness of mainstem and tributary flows, ramping rate restrictions, and other flow-related measures such as Foster Spring Spill (RPA measure 2.8). Flow and ramping rate evaluations are high priority studies because they will provide the information necessary to identify any

necessary changes in project operations to protect UWR Chinook salmon and UWR steelhead. If studies indicate that different flows or ramping rates would be more effective at protecting fish, then the Action Agencies could carry out such changes as quickly as possible to ensure fish protection during this interim period.

The effect of this measure is that study results will be used to modify project operations and flows to improve UWR Chinook salmon and UWR steelhead survival in the tributaries below Project dams and in the mainstem Willamette River. Life stages affected will be fry and juveniles from stranding, smolting juveniles during migration, adults during migration and holding, and eggs in redds from dewatering associated with Project ramping.

9.3 WATER CONTRACT PROGRAM

One of the authorized purposes of the Willamette Project is the distribution of stored water to users who have contracts with Reclamation for irrigation use. As described in Effects Section 5.1, diversion of water to serve these contracts can adversely affect UWR Chinook and UWR steelhead by reducing the amount of stream flow available for use by all life stages and by entraining juveniles into water diversions. These RPA measures are intended to minimize the effects of diverting water served by Reclamation contracts on listed species by limiting the volume of new contracts that can be issued, requiring existing contract diversions to install screens and other fish passage devices within specified timeframe, requiring screening of all new contract diversions, ensuring that water released to serve contracts does not diminish water available to meet minimum flow objectives, and reducing the volume of stored water diverted to contract holders in low water years to ensure minimum objectives are met. These measures will also minimize destruction and adverse modification of critical habitat due to water diversions because they limit the total amount of water that can be diverted and require fish protection measures at the diversions.

RPA 3 Bureau of Reclamation Water Contract Program

Reclamation and the USACE will continue the existing irrigation contract water marketing program for the Willamette Project. Reclamation will issue new contracts, except as specified in RPA measure 3.1 below regarding new contracts in the N. and S. Santiam subbasins, and provided that the total water marketing program, including existing contracts, does not exceed a total of 95,000 acre feet. In the event that future irrigation demand exceeds 95,000 acre-feet, Reclamation and the USACE will reevaluate the availability of water from conservation storage for the water marketing program and reinitiate consultation with the Services if they propose to issue additional contracts.

In addition, all contracts will be subject to the availability of water, as determined by USACE. Therefore water may not be available for some or all of each year in order to meet ESA requirements and other project obligations for instream flows (e.g. minimum flows to protect water quality). Reclamation

may issue notices, orders, rules, or regulations governing water service as necessary to comply with the requirements of the ESA, including appropriate biological opinions and Incidental Take Statements.

Rationale/Effect of RPA 3: This measure builds on a similar action described in section 3.9 of the Supplemental BA (USACE 2007a). NMFS describes the effects of the Action Agencies' Proposed Action in the General Effects Section 5.1. In that section, NMFS finds that in most years and in most of the Project-affected tributaries, sufficient water is available to meet fish flow needs and still supply a water marketing program of up to 95,000 acre-feet and that Reclamation's contract language affords it the ability to curtail irrigation water deliveries when insufficient water is available to meet both instream flow needs and irrigation demand. (Measure 3.1 addresses NMFS' finding that there is insufficient water available to meet both fish flow and contract needs in the North Santiam and South Santiam rivers in most years). This measure specifies that as new contracts are issued and existing ones are renewed, Reclamation must make sure that the total amount of contracted water stays at or below 95,000 acre-feet. If future demand is for more than the existing total, then Reclamation and USACE must reinitiate consultation prior to issuing contracts that would exceed the 95,000-acre-foot limit.

The effect of this measure is to ensure that adequate water is available for possible use for protection of listed fish in the tributaries and mainstem Willamette. This measure also minimizes adverse effects on critical habitat by providing enough water so that minimum flows needed for properly functioning habitat are not precluded by the contract program.

3.1 **<u>New Contract Issuance</u>: Reclamation will not issue irrigation water service contracts in the North Santiam River and the South Santiam River that would in total exceed the current total of 11,574 ac ft (85 cfs) and 1,096 ac ft (7 cfs) respectively.**

The USACE will update its flow exceedance models (similar to Appendix C of the Supplemental BA; USACE 2007a) every five years, and, together with results of fish flow studies, determine whether additional water is available during most years for new irrigation contracts based on this information. If, based on these analyses and other information, the USACE determines that additional water is available to serve irrigation demand (beyond the volumes specified above) without adversely affecting listed fish and their critical habitats, then the USACE will inform Reclamation and seek the written agreement of the Services. The Services will inform the USACE in writing whether they agree[11] with the USACE's determination. If the result of this process is an affirmative determination that additional water is available, Reclamation may issue new contracts based on and limited by the USACE's determination.

Rationale/Effect of RPA 3.1*:* NMFS includes this measure to prevent further reductions in streamflow in the North and South Santiam rivers until and unless a showing is made

[11] See RPA 1.3 & 1.4 for elaboration of decision making process.

that additional water is available. The North and Santiam rivers are core population areas for UWR Chinook and UWR steelhead. As described in RPA 2.4, tributary minimum flows are needed to provide adequate rearing, spawning, holding and migration habitat for UWR Chinook salmon and UWR steelhead. Analysis conducted by the USACE and summarized in tables 5.5-2 (South Santiam Effects section) and 5.6-1 (North Santiam Effects section) indicates that minimum tributary flows are not met during certain months of the year. In the South Santiam, USACE estimates a 25% chance of not meeting the 1500 cfs minimum flow for Chinook spawning from September 1 through October 15, a 20% chance of not meeting the 1100 cfs Chinook incubation flows from October 16 through January 31, and a 20% chance of not meeting the 1500 cfs steelhead spawning flows from March 16 through May 15. In the North Santiam, Chinook spawning flows of 1500 cfs are not likely to be met about 5% of the time.

Additionally, as described in the North Santiam Effects section 5.6.2.1 and in RPA measure 2.4 (tributary minimum flows), the Action Agencies release minimum flows at the dams, but have no authority to enforce these minimums through tributary reaches. In the North Santiam, although the chance of not meeting summer rearing flows of 1000 from July 16 through August 31 is less than or equal to 1% at Big Cliff Dam, the likelihood that this flow will be sustained through the reach downstream to the confluence with the South Santiam is low. OWRD has issued water rights for up to 2,730 cfs from the N. Santiam River between Big Cliff Dam and the South Santiam confluence (about half of which is used for hydroelectric power and affects a short stretch of river). While total diversions seldom if ever reach this total permitted amount, diminished flows have been identified as a limiting factor for UWR Chinook and UWR steelhead in the basin.

Based on this information, it is clear that permitting additional water to be diverted from the stream would further reduce the likelihood of meeting minimum flows and result in less habitat available for rearing, spawning, and incubation. Because OWRD has determined that natural flow is unavailable in the North Santiam River, this curtailment of further water service contract issuance effectively protects the river from further flow reduction.

The effect of this measure is that streamflow in the North and South Santiam rivers would not be further reduced by diversions permitted with new Reclamation contracts. This measure would not improve fish habitat, but it would prevent further degradation. The amount of rearing habitat available to juvenile UWR Chinook and steelhead would continue to be reduced from points of diversion serviced by contracts to the confluence of the mainstem Santiam River with the Willamette during July and August of each year.

3.2 **Existing Contracts: All existing contracted diversions will be required, as a condition of continuing to receive project water, to have fish protection devices that comply with NMFS design criteria, and are approved by NMFS.[12] While this clause is primarily about fish screens, it is not limited to fish screening. Based on the**

[12] Projects that have had, within the last 15 years, site-specific ESA Section 7 consultations performed with respect to fish protection devices are deemed compliant.

effect of the diversion on anadromous fish, fish protection devices could include upstream passage at dams, exclusion of fish from irrigation water return channels, and other fish hazards presented by water diversion practices. Contractors that do not comply with Reclamation's notice or otherwise fail to obtain certification by NMFS as having adequate fish protection devices will not be eligible to continue to receive irrigation water service from the Project and their contract may be subject to termination. The compliance deadline is April 1, 2010, unless a later date is authorized by NMFS.[13]

1. **By October 1, 2008, Reclamation will send written notification to all existing contractors notifying them that in order for them to continue receiving irrigation water service from the Project, their diversions must have fish protection devices that comply with current NMFS fish protection requirements,[14] and are approved by NMFS. Contractors will be required to request assessment by entities listed in the Bureau's written notification letter. Within the time frame specified by Reclamation in its notice, contractors will be required to provide Reclamation with written assessment[15] that their diversions conform to NMFS criteria. Reclamation will assemble this information and provide it to NMFS. NMFS will then make a determination as to whether NMFS agrees that the fish protection measures are sufficient to protect ESA-listed fish, and will advise the water user and Reclamation of this determination. NMFS may ask for additional information, or may need to visit the diversions in order to make its determination. If NMFS requests a site visit, NMFS will inform Reclamation.[16]**
2. **While contractors proceed with the fish protection device installation or modification and approval process, they may continue to divert water under the terms and conditions of their existing contracts, as long as they meet the deadline provided to them by Reclamation.**
3. **As another condition of receiving water, every five to seven years, contractors must re-confirm that their diversions are still in conformance with NMFS design guidelines.**

Rationale/Effect of RPA 3.2: This measure requires screening or other appropriate fish passage devices at diversions with existing Reclamation contracts that will not be renewed for a number of years. In most cases, fish entrainment into a diversion is lethal. Measure 3.3 below ensures that these protections will be required at renewal, but does not require immediate screening of all existing diversions.

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[13] Reasons for extending this date might include challenging design requirements, or atypically large and complicated projects.
[14] See Anadromous Salmonid Passage Facility Design, National Marine Fisheries Service, Northwest Region, February 2008, NMFS 2008e
[15] NMFS will accept assessments by ODFW, Reclamation, or others, based on a Memoranda of Understanding between these Agencies and NMFS with respect to technical acceptance criteria.
[16] Initially, all diversions will require a site inspection by NMFS; ideally, however, Reclamation and NMFS will develop a protocol to avoid site visits for every pumped, diversion, particularly small ones.

The effect of this measure is that losses of juvenile Chinook and steelhead due to entrainment or ineffective passage at existing diversions will only continue until April 1, 2010.

3.3 **<u>New & Renewed Contracts – Conditions</u>: Reclamation will require renewed and new contracts to meet all of the following:**

1. **Compliance with NMFS fish protection criteria, as required for existing diversions in 3.2, above.**
2. **Surface water diversions must have lockable headgates that are capable of easily starting, adjusting and stopping[17] the flow of water.[18]**
3. **Diversions greater than 3 cfs must have devices to enable measurement of the instantaneous rate of water delivery, within 5% accuracy.[19] Diversions over 10 cfs must also have a flow totalizer that calculates total volume of water diverted.**
4. **Reclamation will include provisions to curtail or cease entirely all water deliveries in specific areas, if certain flows are necessary to protect listed species and their critical habitats.**

Rationale/Effect of RPA 3.3: This measure is included to ensure that new and renewed contracts include conditions to protect fish from entrainment into diversions and to ensure that rate and volume of water diverted can be easily and accurately controlled. In most cases, fish entrainment into a diversion is lethal. The OWRD now requires new surface water right permittees in the Willamette basin to screen their diversions to avoid entrainment; however, an unknown number of diversions using older federal water service contracts are unscreened.

This effect of this measure is to minimize loss of UWR Chinook salmon and steelhead at diversions that acquire a new or renewed Reclamation contract. During the 15-year term of this Opinion, about 48 of the 205 existing contracts will be eligible for renewal. Harm will be reduced by requiring screens to be installed and operated at contract diversions. Contract conditions requiring headgate flow controls, measurement, and water curtailment will reduce adverse effects on listed fish due to reduced river flow.

3.4 **<u>Annual Availability of Contract Water for Irrigation</u>: Contract fulfillment is subject to the USACE's annual operating plan for the Willamette Basin Project in which the USACE determines availability of water for Reclamation contracts. If USACE determines that a shortage will occur, or is forecasted to occur, USACE can designate this shortage to specific tributary subbasins,**

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[17] To less than 1.0 cfs.
[18] Pumped diversions are presumed to inherently possess this capability.
[19] Any of the measurement methods described in the *Reclamation Water Measurement Manual* for measuring instantaneous flow rate shall be acceptable, but generally for surface water diversions, and pumps that discharge to canals, this will likely be a flume; for flows entirely within conduit, a pipeline flow meter is presumed. Indirect methods based upon pump(s) electrical power consumption require field calibration (USBR 2001a) and an engineer's certification of the correlation between electrical power consumption and flow.

certain reaches, or throughout the Willamette basin, limiting the availability of the contract water supply. Reclamation will notify contractees of storage water shortages as described below. Appendix D further describes how water years are designated and is hereby incorporated into this RPA by reference.

Each year on or before April 1, the USACE will determine availability of water for irrigation contracts based on the best information available at that time.

DEFICIT YEARS:

(a) In "deficit" water years (as defined in Appendix D), the USACE will inform Reclamation that either (1) a specified partial supply or (2) no supply is available for the upcoming irrigation season in specific tributaries and will include this determination in the annual operating plan. The April 1 determination will remain in effect until October 31. The USACE may revise its "deficit" water year determination after April 1 if forecasts change significantly toward a wet year, and may make additional stored water available to meet irrigation contracts.

(b) Reclamation will notify affected contractees that water deliveries will be ceased or curtailed under these circumstances. Reclamation may apply the curtailment or cessation of water deliveries to specific tributaries where it is needed, but not in others, depending on water availability and storage capacity in each basin's reservoirs. Reclamation will also inform the OWRD of such actions.

(c) If the USACE determines initially that a partial supply is available for contractees, but later forecasts indicate even less water is available, in order to protect fish habitat the USACE will release additional flow from the applicable dams to offset the amounts diverted by contractees, based on the partial use that had been permitted on April 1. This additional flow will not be released if, based on coordination through WATER, it is determined these additional flows would impact ability to meet Table 9.2-1 (mainstem) and 9.2-2 (tributary) minimum flows during other seasons.

INSUFFICIENT, ADEQUATE, & ABUNDANT YEARS:

(a) In these water years (as defined in Appendix D), the USACE will usually not make a determination that would curtail contractees' use of water.

(b) Instead, the USACE will release additional flow (over the Table 9.2-2 flow rates) to offset the amount of flow diverted by

contractees, as estimated in Table 3-26 of the Proposed Action (USACE 2007a) (or based on updated estimates by Reclamation of actual use). This measure does not apply to the Coast Fork or Long Tom subbasins.

(c) The schedule for when and if to begin and end additional flow releases will be annually determined through the WATER Flow Management Committee, which will consider fish flow needs, Reclamation's estimate of contract water usage, and reservoir storage available for meeting tributary and mainstem flow objectives throughout the water year.

(d) In tributaries and reaches where the sum total of existing and new contracts is less than 20 cfs or otherwise beyond adjustment capabilities at each project dam, the USACE will attempt to release these additional increments. However, downstream gage data may not detect relatively small increases in flow over Table 9.2-2 releases.

(e) The USACE will not be required to make RPA measure 2.2 deviation reports where contracted flow is less than 20 cfs; NMFS will consider requests to waive RPA measure 2.2 deviation reports in other situations, as well, on a case-by-case basis.

Rationale/Effect of RPA 3.4: Under the Proposed Action, USACE would not increase the discharge rate at individual projects to meet Reclamation contracts, reasoning that established project minimum discharge rates are sufficient to meet those needs and contract diversions take a *de minimus* volume of water. Because the tributary minimum flows established in RPA measure 2.4 are designed to protect listed fish throughout the stream reaches downstream from Project dams, diverting water under Reclamation contracts while Willamette Project dams are discharging to meet minimum flows could put listed fish at risk. This RPA measure requires Reclamation to curtail contract diversions in Deficit water years, and, in all other water years, it requires USACE to release additional water above the minimum flow levels to ensure that contract users do not take water intended for fish purposes.

As a means to reduce risk to contractors, USACE will identify the likelihood of curtailment by April 1, prior to the irrigation season through the development of the Willamette Conservation Plan. Such early notification would assist water users to plan appropriately for a water shortage. In the event that the USACE's forecast is incorrect, and a forecast that appeared adequate (not requiring any curtailments) on April 1st changes to one predicting a "deficit" water year, the USACE will release additional flow at its dams to make up for the contracted amounts. This would protect contractors from interrupted water service mid-season, when it could result in excessive crop damage, but would ensure that streamflows are not further reduced due to contract withdrawals in such flow years.

Curtailments under this measure could be for one or more individual tributaries or the entire basin and could be in force for only a few weeks or the entire irrigation season.

Innovative solutions to minimize impacts to water users, such as rotational diversion timing, may be proposed by Reclamation and OWRD and may be adopted by NMFS.

The effect of this RPA measure is that losses to listed fish species from low stream flows will be reduced while allowing the Action Agencies to continue serving other project purposes to the extent practical. Adverse effects on critical habitat will be reduced because this measure will provide for flows necessary to support listed fish.

9.4 FISH PASSAGE

The Proposed Action included studies to consider passage at Project dams, but did not include specific passage measures and time frames associated with the measures. As discussed in the Effects (Chapter 5) and Summary of Effects (Chapter 7) sections of this Opinion, for UWR Chinook salmon and UWR steelhead, lack of passage is one of the single most significant adverse effects on both the fish and their habitat. In its jeopardy and destruction and adverse modification of critical habitat analyses, NMFS identified the need for more specific measures with associated time frames. Specific passage measures are necessary to address the effects of the Project. Therefore, NMFS includes specific passage measures to be completed and operational by set deadlines. NMFS also includes a measure to ensure that the Action Agencies continue to work toward providing more specific passage measures, if appropriate, past the time frame of RPA.

RPA 4 Fish Passage

4.1 **<u>Adult Chinook Salmon Outplanting</u>: The Action Agencies will continue capturing spring Chinook salmon below USACE dams and transporting them into habitat above the following dams:**

- **Detroit Dam in the North Santiam River basin;**
- **Foster Dam in the South Santiam River basin;**
- **Cougar Dam in the South Fork McKenzie River basin;**
- **Lookout Point and Hills Creek dams in the upper Middle Fork Willamette River subbasin; and**
- **Fall Creek Dam in the Fall Creek River basin.**

Additionally, if NMFS, after coordination with the Fish Passage and Hatchery Management Committee (FPHM) of WATER, determines it is necessary to evaluate passage at Green Peter Dam, then the Action Agencies will also release Chinook salmon above that dam in the South Santiam.

The Outplant Program will provide upstream fish passage for adults via "trap and haul" facilities while USACE carries out studies to assess upstream and downstream fish passage alternatives at these dams and reservoirs (see RPA measures 4.10, 4.11, and 4.12 below). The interim operational guidelines and protocols for outplanting fish will be as described in section 3.4.5 of the Supplemental BA (USACE 2007a),

NMFS (2006f) and section 15 of each ODFW (2003, 2007a, 2008a, and 2008b).[20] The Outplant Program will be carried out consistently with the guidelines, protocols, and criteria specified in the Willamette Fish Operations Plan (see RPA measure 4.3 below) and annual revisions to this plan (see RPA measure 4.4 below). (See also RPA measure 6.2.3 below, which references this same Outplant Program as part of the hatchery-related measures).

Rationale/Effect of RPA 4.1: This measure is generally consistent with section 3.4.5.3 of the Proposed Action (USACE 2007a), in which the Action Agencies propose to continue the Outplant Program consistent with a philosophy described in detail in section 3.4.4.5 of the Proposed Action. The outplant program is a first step to provide UWR Chinook salmon and UWR steelhead access to historical habitat above Project dams, but by itself won't be sufficient. The major distinction between the PA and RPA for the outplanting program is that harm to listed fish should be decreased by following guidelines developed to minimize effects on the fish.

As described in the Effects sections for the major subbasins (Middle Fork Willamette, section 5.2; McKenzie, section 5.3; South Santiam, section 5.5; and North Santiam, section 5.6), the outplanting measures in the PA do not provide safe passage. Therefore, improvements in fish trapping, handling, transport, and release are needed to minimize stress and injury to adult fish. The interim guidelines and protocols, as implemented by the Action Agencies, will help to reduce fish stress and injury.

The Outplant Program, as modified based on monitoring and evaluation and with improved trapping facilities described in RPA measure 4.6, will provide adequate temporary upstream passage to ensure fish access to historical habitat. In most situations where fish passage at a dam is needed, NMFS would consider volitional passage via a fish ladder or other fishway as its first choice alternative. However, for the Willamette Project dams, in this case, sufficient improvements in upstream passage can be achieved in the short term with improved fish trap and transport facilities while efforts are focused on achieving safe downstream fish passage through the dams and reservoirs. Once downstream fish passage facilities are completed and demonstrated to provide safe and timely passage, then NMFS will reconsider whether volitional upstream passage is needed at certain Project dams.

This measure requires the Action Agencies to transport listed fish to the described locations. Fish habitat above dams was historically preferred for spawning and rearing. Since dam construction, remaining fish habitat below dams has been degraded by dam and reservoir operations, as well as other actions such as land use and agricultural and industrial water pollution. Lack of access to good habitat is considered a major reason for the decline in productivity of UWR Chinook, and most of the good habitat, and hope for restoring productivity, lies above project dams.

[20] Hatchery and Genetic Management Plans (ODFW 2003, 2004a, 2005, 2007a, 2008a, and 2008b) are described in the salmon and steelhead 4(d) rule as a mechanism for addressing "take" of ESA-listed species that may occur as a result of artificial propagation activities.

The effect of this measure will be to require efforts to restore productivity of listed fish. Restoration of productivity is key to adequately addressing the effects of the Project because the extremely low numbers of wild fish caused by lack of or inadequate access to historical habitat are the major factor contributing to the species' decline. Lack of access to good habitat above the dams, injury and mortality associated with inadequate passage facilities, and restriction to degraded habitat below the dams has caused steep declines in numbers and has reduced the functioning of PCEs of critical habitat.

4.2 **Winter Steelhead Passage: The Action Agencies will continue to trap adult winter steelhead at Foster Dam in the South Santiam River and transport them to release sites above Foster reservoir. If NMFS and the Action Agencies, in coordination with the FPHM of WATER, determine it necessary for evaluation of winter steelhead passage at Green Peter Dam, then the Action Agencies will release some portion of the winter steelhead captured at the Foster Dam trap above Green Peter reservoir in the South Santiam. Additionally, if NMFS and the Action Agencies, in coordination with the FPHM, determine it necessary for evaluation of steelhead passage at Detroit and Big Cliff dams, then the Action Agencies will trap winter steelhead at the Minto Trap or other locations in the North Santiam River below Big Cliff Dam and release them above Detroit and/or Big Cliff dams, as directed by NMFS.**

Rationale/Effect of RPA 4.2: The Outplant Program described above in RPA measure 4.1, has focused on upstream passage of UWR Chinook salmon, but UWR steelhead access to historical habitat in the South and North Santiam rivers is also needed. In the South Santiam subbasin, the Action Agencies have continued to pass UWR steelhead above Foster Dam since dam construction, relying on a surface spill program to flush juvenile steelhead from the reservoir during the peak migration period. As described in Section 4.5.3 (Baseline South Santiam), upstream passage at Green Peter Dam was discontinued in 1988 because adults were not attracted to the cold water from the ladder and a low percentage of downstream migrants were collected in the downstream fish collection facility. This measure requires the Action Agencies to continue to pass UWR steelhead above Foster Dam, and possibly, above Green Peter Dam.

In the North Santiam subbasin, steelhead passage to historical habitat above Big Cliff and Detroit dams was blocked in 1953, when construction of the dams without fish passage facilities was completed (see section 4.6.3, Baseline North Santiam). As described in Effects Section 5.6, UWR steelhead spawn in the North Santiam below Big Cliff Dam. Although water quality and sediment transport are degraded in this reach due to continued dam operation, this population is considered to be at "moderate" risk of extinction. (UWR Chinook salmon, on the other hand, are at a "very high" risk of extinction). Because there is not a hatchery component of winter steelhead, NMFS is reluctant to release winter steelhead above Big Cliff and Detroit until downstream fish passage is shown to be safe with existing structures or until new facilities are installed that provide safe passage. RM&E studies will evaluate potential benefits of steelhead passage at Big Cliff and Detroit. Based on the results of the studies, NMFS, after

coordination with the FPHM, may determine that passage of UWR steelhead is appropriate during the term of this Opinion.

The effect of this RPA will be to ensure that UWR steelhead are provided safe upstream passage in the North and South Santiam subbasins, if determined feasible and necessary based on RM&Es. Lack of passage was a significant factor in the species' decline, and assuming passage is determined effective at Detroit and Big Cliff on the North Santiam and at Foster and Green Peter on the South Santiam, these populations will likely increase in abundance and productivity by allowing steelhead to use good spawning and rearing habitat above the dams.

4.3 **Willamette Fish Operations Plan: The Action Agencies will complete a Willamette Fish Operations Plan (WFOP) by October 1, 2008. The Action Agencies will coordinate with the Services when preparing the WFOP. This Plan and its annual revisions will be consistent with this Opinion and incidental take statement, and will take into account and be coordinated with related biological opinions issued by the USFWS to the fullest extent practicable. The Action Agencies will carry out measures identified in the WFOP and in annual revisions to the WFOP. The WFOP will include, but not be limited to, the following:**

1. **Identify optimal operating criteria for Green Peter, Foster, Detroit, Big Cliff, Cougar, Fall Creek, Dexter, Lookout Point, and Hills Creek dams to minimize adult and juvenile fish injury and mortality to the extent possible with existing facilities and operational capabilities;**

2. **Identify protocols for optimal handling, sorting, and release conditions for ESA-listed fish collected at USACE-funded fish collection facilities, including but not limited to those at Minto fish facility, Foster Dam fish collection facility, McKenzie Hatchery, Fall Creek fish facility, Dexter Dam fish collection facility, and at the new facilities at Cougar and Leaburg dams, when they are constructed;**

3. **Identify the number, origin, and species of fish to be released into habitat upstream of USACE dams, incorporated into the hatchery broodstock, or taken to other destinations;**

4. **Describe scheduled and representative types of unscheduled maintenance of existing infrastructure (dams, transmission lines, fish facilities, etc) that could negatively impact listed fish, and describe measures to minimize these impacts;**

5. **Describe procedures for coordinating with federal and state resources agencies in the event of scheduled and unscheduled maintenance.**

6. **Describe protocols for emergency events and deviations:**

a) Protocol Development: The USACE will establish a formal, written procedure for taking actions to prevent or minimize adverse impacts to ESA-listed fish, including water quality impacts, during unusual events/conditions. These protocols will guide the actions of project personnel.

b) In the event of an emergency outage or malfunction, the Action Agencies will inform the Services of the emergency by phone or email, as soon as practical, but not later than 24 hours after the event. This process will also apply whenever the Action Agencies carry out flood reduction operations that result in deviations from the flow measures described in this section.

c) The Action Agencies may initiate work prior to notifying the Services, when delay of the work will result in an unsafe situation for people, property, or fish. For each occurrence of unscheduled maintenance and each flood damage reduction operation that results in a deviation from minimum mainstem flow objectives, minimum and maximum tributary flow objectives, ramping rates, spill at Foster Dam, or adverse TDG and water temperature conditions, the USACE will inform the Services in writing (or email) within 24 hours, and include a description of the problem, type of outage required, potential impact on ESA-listed fish, estimated length of time for repairs or flood damage reduction operation, and proposed measures to minimize effects on fish or their habitat. This approach will be taken only if it is not possible to coordinate with the Services prior to starting the maintenance event or flood damage reduction operation.

Rationale/Effect of RPA 4.3: The WFOP will replace the Action Agencies' proposed Willamette Fish Passage and Management Plan, identified in the Proposed Action, 2007 Supplemental BA at sections 3.2.2 (p. 3-18) and 3.4.5.3 (p. 3-48). All of the features of the Action Agencies' proposed plan will be included in the WFOP, but it will also include important operational requirements not directly related to fish passage such as outflow protocols during emergencies to protect fish spawning in habitat below Project dams. The WFOP is a critical link between measures required by the Proposed Action and this RPA and on-the-ground implementation activities. The WFOP will guide Project personnel, including contractors and other agencies responsible for carrying out fish hatchery and passage measures, and will help to ensure that fish facilities are operated based on best practices and consistent with the terms of this Opinion.

By including emergency operations within the WFOP, field staff will have a single manual to rely on for all fish-related protocols, including steps that should be taken in emergency situations to minimize adverse fish effects. The notification protocols measure (number 6 in the list above) adds reporting details to a similar action described in section 3.3.4 of the Supplemental BA (USACE 2007a), and requires the Action Agencies to notify the Services within 24 hours of an unscheduled event rather than the

48 hours required by the Proposed Action measure. NMFS requires timely notification and reporting of these events in order to initiate damage assessments and to advise the Action Agencies on a preferred course of action to minimize adverse fish impacts.

The effect of this measure will be to reduce stress, injury, and mortality to adult fish caused by the Outplant Program by ensuring field personnel have clear instructions for carrying out this Program. The Plan will also minimize fish injury and mortality caused by emergency operations by providing clear directions to field staff for dealing with emergencies in a manner that is protective for listed fish. Additionally, NMFS will be able to quickly assist the Action Agencies in defining measures they should take to minimize and avoid fish losses, and NMFS will be able to assess losses when needed.

4.4 **Annual Revision of Willamette Fish Operations Plan (WFOP): The Action Agencies will annually revise and update the WFOP, including the "Fish Disposition and Outplant Protocol" sections of each chapter to describe how and where outplanted fish will be collected, held, marked, sampled, transported, and released and to incorporate changes in operations needed to protect fish. The WFOP will be revised annually based on results of RM&E activities, construction of new facilities, recovery planning guidance, predicted annual run size, and changes in hatchery management. Annual revisions will be submitted to the Services by January 15 of each year for review and comment; the Services will inform the Action Agencies by February 15, whether they agree[21] with the revised WFOP. The Action Agencies will release a final updated WFOP by March 14 of each year. Annual revisions will be considered an "Annual Milestone" as defined below in RPA measure 4.13.**

Rationale/Effect of RPA 4.4: As described above for RPA measure 4.3, the WFOP builds upon the Willamette Fish Passage and Management Plan that the Action Agencies proposed. This measure specifies dates by which the Action Agencies will release a draft plan for review by the Services, a process for review and comment on the draft plan, and a deadline for completion of the updated WFOP. This will ensure timely completion of this manual prior to the primary fish passage season each year. It will also require coordination with NMFS to ensure that proposed changes are consistent with the intent of this Opinion.

The effect of the measure is that the WFOP will be kept up-to-date with information learned from previous years' operations as well as results of RM&E studies. This new information will ensure that revised practices for handling, sorting, transporting, and releasing fish will be carried out within the next year, or sooner, after such changes are indicated by new information. As a result, UWR Chinook salmon and UWR steelhead that are collected and released above Project dams will experience less stress, injury, and mortality, and fish abundance and productivity will increase due to improved fish passage to historical habitat. Similarly, annual updates will ensure the latest information is

[21] See RPA 1.3 & 1.4 for elaboration of decision making process.

incorporated in the WFOP, and will result in reduced fish injury and mortality caused by emergency operations.

4.5 **Employee Training for Fish Protection Operations at Project Dams and Fish Facilities: The Action Agencies will ensure that fish facility personnel, operators, and managers responsible for operating and maintaining fish facilities at each project complete an annual employee environmental awareness training program. The training will include a review of the status of ESA listed aquatic species, the WFOP, and each fish facility's standard operation procedures (SOPs). Prior to conducting the annual training, the Action Agencies will coordinate with the WATER and appropriate natural resource agencies to identify any specific resource issues that should be addressed or emphasized at that time. The Action Agencies will maintain records of the training including agendas, attendance lists, and any handout materials.**

Rationale/Effect of RPA 4.5: The Proposed Action does not explicitly require staff training in how to operate fish facilities and how to handle emergencies to minimize harm to listed fish. Although hatchery personnel presently are trained to operate fish collection and transport facilities, other Project staff should be trained in emergency procedures for on-site fish facilities. If a water supply line to a fish holding pond broke and no hatchery personnel were able to respond quickly, simple directions could be given to an on-site Project operator or maintenance staff to open emergency water supply systems or otherwise provide temporary relief to trapped fish until hatchery personnel are available. The effect of this measure will be to ensure that all staff responsible for carrying out measures in the RPA and Proposed Action are well-trained in safe fish handling procedures and are able to knowledgeably and safely use mechanical equipment. The training will also ensure that fish facility personnel, as well as other Project staff, are able to quickly respond to emergencies to minimize effects on listed fish and fish habitat.

4.6 **Upgrade Existing Adult Fish Collection and Handling Facilities: The Action Agencies will design, construct, install, operate and maintain new or rebuilt adult fish collection, handling and transport facilities at the sites listed below. The Services will inform the Action Agencies whether they agree[22] with each facility's planned configuration and operation. The Action Agencies will design each facility with and incorporate NMFS' Anadromous Salmonid Passage Facility Design (NMFS 2008e) and the best available technology. During the design phase, the Action Agencies will coordinate[23] with the Services to determine if the design should accommodate possible later connection to a fish ladder, if determined necessary in future years beyond 2015.**

The Action Agencies will complete all necessary interim steps in a timely fashion to allow them to meet the following deadlines for completing construction and beginning operation of the facilities listed below. These steps may include completing a DDR and plans and specifications. The Action Agencies will give

[22] See RPA 1.3 & 1.4 for elaboration of decision making process.
[23] See RPA 1.3 & 1.4 for elaboration of decision making process.

NMFS periodic updates on their progress. The order in which these facilities are completed may be modified based on interim analyses and biological priorities, and with agreement[24] of NMFS and USFWS.

1. **North Santiam Fish Facility (currently at Minto Pond) – complete construction no later than December 2012; begin operation no later than March 2013.**
2. **Foster Fish Facility – complete construction by December 2013; begin operation by March 2014.**
3. **Dexter Ponds Fish Facility – complete construction by December 2014; begin operation by March 2015.**
4. **Fall Creek Dam Trap – complete construction by December 2015; begin operation by March 2016.**

Rationale/Effect of RPA 4.6: The Action Agencies proposed to evaluate and modify these fish facilities in Section 3.6.3 of the Supplemental BA (USACE 2007a), but did not provide certainty in when the improvements would be made or whether funding would be available to do the work. NMFS makes clear that facility improvements or replacement are required, and establishes dates to complete work and begin operation. In some cases, work could be initiated sooner than listed above, and NMFS expects the Action Agencies to make these improvements as soon as possible.

Improvements in fish trapping are needed at each of the fish collection facilities to minimize stress and injury to adult fish, as described in the Effects sections for the major subbasins (Middle Fork Willamette, section 5.2; McKenzie, section 5.3; South Santiam, section 5.5; and North Santiam, section 5.6). Although there is no single known cause of pre-spawning mortality, stress induced during fish collection and handling is likely one component of this mortality that can be lessened by redesigning these trapping facilities using latest fish handling design criteria. Because these facilities will be used in lieu of volitional fish passage to provide access to historical habitat above the dams, this measure is an essential first step toward addressing low population numbers caused by decreased spatial distribution, which is a limiting factor for UWR Chinook salmon and UWR steelhead. This measure also addresses the critical habitat PCE factor of providing freshwater migration corridors free of obstruction, despite the fact that traps and transportation will be used to provide a migration corridor past some of the Project dams. The improvements to the fish facilities will also allow hatchery fish to be acclimated before release, a practice that will improve survival and reduce straying.

The effect of this measure is that improved collection and release of adult fish will minimize fish stress and injury, resulting in improved upstream fish passage to historical habitat. Upstream fish passage is the initial step toward restoring productivity of listed fish by using large reaches of good quality habitat above Project dams. Lack of access to good habitat above the dams, injury and mortality associated with inadequate passage facilities, and restriction to degraded habitat below the dams has caused steep declines in numbers and has reduced the functioning of PCEs of critical habitat.

[24] See RPA 1.3 & 1.4 for elaboration of decision making process.

4.7 **Adult Fish Release Sites above Dams: The Action Agencies, working in coordination with the U.S. Forest Service (USFS) or other applicable landowners,[25] will:**

- **Complete a site/concept study by February 28, 2009, that will identify at least four to six potential locations suitable for new adult fish release sites for Chinook salmon above Detroit, Foster, Lookout Point, Hills Creek, Fall Creek, and Cougar reservoirs. Sites located above Foster Reservoir will be suitable for releasing both Chinook salmon and winter steelhead; site(s) above Detroit and Green Peter dams should also be suitable for winter steelhead, should adult steelhead be released in these locations in future years.**
- **The Action Agencies will work with the USFS and the Services to prioritize and design each release site, which may include infrastructure to minimize stress and injury of adults (e.g., piping systems, vehicle ramps, etc). The release sites will be prioritized in the context of the Configuration Operation Plan (COP) (see RPA measure 4.13). The Services will inform the Action Agencies whether the sites as designed are consistent with the Opinion.**
- **The Action Agencies will complete construction of all selected sites by June 2012. If another entity, by December 2010, takes on the responsibility for constructing or improving these sites, the Action Agencies will not be responsible for construction of those sites completed by another entity. Additionally, if, based on results of the COP, additional sites are warranted, construction of additional sites will be completed as soon as possible after identified by the COP. Construction of the sites will be contingent upon availability of funds (which may include a non-federal cost-sharing requirement) and cooperation of landowners. Prior to construction, the Action Agencies will need to complete processes to ensure compliance with all applicable statutes and regulations not provided by this or other ESA consultations, as required by applicable law.**

Rationale/Effect of RPA 4.7: This measure builds upon one proposed by the Action Agencies in Section 3.4.5.3 of the Supplemental BA (USACE 2007a, p 3-51), but NMFS has added a minimum requirement of 4 to 6 sites, as well as dates for completion of construction and a requirement that sites above the Santiam dams be made compatible for steelhead as well as Chinook salmon release.

Improvements in release of outplanted adult fish are needed to minimize fish stress and injury, as described in the Effects sections for the major subbasins (Middle Fork Willamette, section 5.2; McKenzie, section 5.3; South Santiam, section 5.5; and North

[25] NMFS acknowledges that establishment of release sites above reservoirs may be contingent upon securing funds and agreement with non-Action Agency landowners/land managers such as USFS and BLM. NMFS also understands that some entities such as USFS and BLM may elect to undertake work on the property they manage themselves, in which case Action Agencies would cooperate with them, including funding the work, if necessary. Environmental permitting not provided by this or other ESA consultations may also be required before this work can be accomplished.

Santiam, section 5.6). This is one more component (in addition to trapping facilities and handling and transport protocols described in RPA measures above) that is likely to help decrease the rate of pre-spawning mortality. Many of the existing release sites have relatively poor river access, forcing drivers to release fish using methods such as sliding fish on tarps or using collapsible hoses that elevate stress or cause direct or delayed injury or mortality. Some sites are located at river access points that experience heavy recreational pressure, leading to disturbance, harassment, or poaching of outplanted fish. New release sites will be chosen to allow safe transfer of fish from the truck, adequate recovery in pools without recreational pressure or poaching, and reasonable proximity to quality holding and spawning habitat.

The effect of this measure will be to reduce stress and associated pre-spawning mortality, ultimately increasing the percent of adult fish that successfully spawn, leading to increased productivity above the dams. This measure will also decrease adverse effects on critical habitat by providing a component of safe passage.

4.8 **<u>Interim Downstream Fish Passage through Reservoirs and Dams</u>: Until permanent downstream passage facilities are constructed or operations are established at Project dams and reservoirs in subbasins where outplanting of UWR Chinook salmon and steelhead is underway, the Action Agencies will carry out interim operational measures to pass downstream migrants as safely and efficiently as possible downstream through Project reservoirs and dams under current dam configurations and physical and operational constraints, and consistent with authorized Project purposes.**

Near-term operating alternatives will be identified, evaluated, and implemented if determined to be technically and economically feasible and biologically justified by the Action Agencies and Services, within the framework of the Annual Operating Plan updates and revisions and in coordination with the WATER Flow Management Committee.[26]

The Action Agencies will evaluate potential interim measures that require detailed environmental review, permits, or Congressional authorization as part of the COP (see RPA 4.13 below). The Action Agencies will complete this component of the COP by April 2011, including seeking authorization (if necessary) and completing design or operational implementation plans for those operations selected by the COP. The measures that will be considered in the COP include, but are not limited to, partial or full reservoir drawdown during juvenile outmigration period, modification of reservoir refill rates, and using outlets, sluiceways, and spillways that typically are not opened to pass outflow. The Services will inform the Action Agencies whether they agree[27] with the interim downstream passage measures. The Action Agencies will begin to carry out measures selected by the COP by May 2011, contingent on funding, authorization, and compliance with all applicable

[26]See RPA 1.3 & 1.4 for elaboration of decision making process.

[27] See RPA 1.3 & 1.4 for elaboration of decision making process.

statutes and regulations. One specific measure is listed below, and others may be developed in coordination with the WATER, if appropriate.

Rationale/Effect of RPA 4.8: The Proposed Action describes a formidable series of studies that would be required before the Action Agencies could construct downstream fish passage structures or make major operational changes to improve downstream fish passage at Project dams and reservoirs. Although it will take many years to investigate, design, and install structural downstream fish passage facilities at those Project dams where such facilities are determined necessary and feasible, there are some fish protective measures that can be carried out in the near future without requiring significant modification to existing structures or operations. Alternative interim measures that need to be considered include short-term operations such as reservoir drawdown, pulsing flow releases, opening various valves, or spill to safely pass fish downstream through a reservoir and dam.

The magnitude of effect of these interim measures is difficult to predict because insufficient data is available to determine where these measures would take place and how successful they would be in providing downstream fish passage for juvenile Chinook and juvenile and kelt steelhead. Such measures would likely be initiated for a short time period as part of an RM&E study to determine potential effectiveness of the measure before an annual or longer term commitment is made. Studies at some non-Project dams have shown that relatively large proportions of downstream migrants pass via spill or sluiceways (see discussion of Willamette Falls Hydroelectric Project in section 4.10, Mainstem Willamette Baseline). However, until interim measures are evaluated to assess fish passage effectiveness, NMFS can only assume that these measures will result in an unquantified improvement in fish survival. This increased survival would benefit the populations of UWR Chinook and UWR steelhead in the subbasins where interim measures are used (possible in any of the following: North Santiam, South Santiam, McKenzie, Fall Creek, and Middle Fork Willamette). Improved downstream survival would help to address the spatial access VSP parameter by increasing the likelihood that the Outplant Program will result in sustainable production above the dams. Sustainable production above the dams would also improve productivity and abundance of populations by increasing the total available habitat while limiting dam-related losses. This measure will also decrease adverse effects on critical habitat by providing a component of the PCE, "migration corridors free of obstruction," while more permanent passage options are being developed.

4.8.1 **<u>Fall Creek Drawdown</u>: Beginning in Water Year 2008, the Action Agencies will adjust timing of storage and release of flow at Fall Creek Reservoir to promote downstream passage of juvenile Chinook salmon through the reservoir and dam. Drawdown will be to at least elevation 714.0 by the end of November each year, and the Action Agencies will hold the reservoir at this elevation during all of December and January except during flood events, and possibly longer. The Action Agencies will conduct monitoring and evaluation studies to determine the effectiveness of the operation and to assist in deciding whether or not to continue the operation in future years.**

The depth and timing of the drawdown may be adjusted in subsequent years, based upon monitoring results, with NMFS' agreement.[28] During this operation, when inflow is less than Project minimum flow objectives and the reservoir is at or below 714.0', then outflow will equal inflow and this will not be considered a deviation from flow objectives.

Rationale/Effect of RPA 4.8.1: Past studies have indicated that juvenile spring Chinook salmon migrate from Fall Creek Reservoir primarily during November, and that smolts passing through the regulating outlet under conditions of lower reservoir elevations survived at higher levels than when the reservoir was held high (see Section 4.2.3 Middle Fork Willamette Baseline). Also, smolts migrating late in the season under conditions of very low head appeared to sustain lower injury or mortality rates compared to passage under high reservoir levels. If the reservoir is drawn down to an elevation below minimum conservation pool, NMFS would expect increased survival of juvenile Chinook salmon emigrating during November.

The effect of this measure will be to improve downstream fish passage survival through Fall Creek dam and reservoir, increasing productivity of the Fall Creek Chinook salmon population and ultimately resulting in increased abundance and improved spatial distribution. Another effect of this measure will be to minimize adverse effects on critical habitat by providing a component of the PCE, "migration corridors free of obstruction."

4.9 **Head-of-Reservoir Juvenile Collection Prototype: The Action Agencies will plan, design, build, and evaluate a prototype head-of-reservoir juvenile collection facility above either Lookout Point or Foster reservoir. If Foster reservoir is chosen for testing the prototype, the Action Agencies will design for collecting both juvenile salmonids and steelhead kelt. The Action Agencies will complete construction by September 2014. As an interim step, the Action Agencies will complete feasibility studies as part of the COP (described in RPA measure 4.13) near the end of 2010. At that time, the Action Agencies will make a "go/no go" decision on the feasibility of the prototype facility(s) and the preferred location(s) and design(s) for construction of the prototype(s). The Action Agencies will make the go/no go decision in coordination with the FPHM, and after agreement by NMFS.**

After construction is completed, the Action Agencies will conduct biological and physical evaluations of the head-of-reservoir prototype collection facilities in 2015 and 2016, with opportunities for review and comment by the FPHM and RM&E committee of study proposals and draft reports. After receiving comments, including the Services' statements regarding whether they agree[29] with the draft report, the Action Agencies will make necessary revisions to the draft report and issue a final report by December 31, 2016, on the effectiveness of the facilities, including recommendations for installing full-scale head-of-reservoir facilities at

[28] See RPA 1.3 & 1.4 for elaboration of decision making process.
[29] See RPA 1.3 & 1.4 for elaboration of decision making process.

this and other reservoirs. If the report concludes that head-of-reservoir facilities are technically feasible, capable of safely collecting downstream migrating fish, and capable of increasing the overall productivity of the upper basins, then the Action Agencies will include such facilities in the design alternatives that they consider in the COP studies described in RPA measure 4.13 below.

Rationale/Effect of RPA 4.9: This measure addresses the lack of effective downstream fish passage facilities described in the Effects sections for the major subbasins with Project dams (Middle Fork Willamette, section 5.2; McKenzie, section 5.3; South Santiam, section 5.5; and North Santiam, section 5.6). Past monitoring of downstream juvenile migration through the reservoirs and dams was minimal, although in some reservoirs (e.g., Green Peter, South Santiam, section 5.5) studies indicated that juvenile fish were not successfully migrating through the reservoir to collection facilities at the face of the dam. Regardless of whether this was caused by predation, lack of attraction to collection facilities, or another reason, these results support the notion that collecting fish near the head of a reservoir might be an effective means to achieve safe downstream passage.

Because the head-of-reservoir fish collection concept is virtually untested, it would be imprudent to require such facilities without prior field studies, design, and prototype testing to validate the concept. For this measure, NMFS defines "prototype" to refer to temporary facilities intended for concept evaluation, not long-term operations. Further, "prototype" does not necessarily refer to a single concept; multiple concepts may be experimented with simultaneously. The FPHM subcommittee of the WATER group, comprised of fish biologists and engineers with experience in fish passage design, will be an appropriate forum in which to develop concepts. NMFS' current thinking on possible means to accomplish this is 1) floating collectors in the reservoir near the mouths of tributaries and 2) fish collection facilities on tributaries above the reservoir pools. After several years of field monitoring and conceptual design review, the Action Agencies will identify a Major Milestone (MM2) (as described in RPA measure 4.13 below) near the end of 2010 in conjunction with completion of the DDR. The major decision associated with that milestone will be "go/no go" on the feasibility of the prototype facility(s), after coordination with the FPHM and agreement by NMFS. If the decision is to construct and evaluate the prototype(s), the focus of the decision will potentially be focused on alternative location(s) and design(s) for the prototype facility(s). Among the questions to be answered are whether such a device could capture enough fish to be biologically useful, and whether it could be operated during periods of high flow and debris loading.

The effects of this measure would be to initially demonstrate whether this concept is feasible, and if so, to use head-of-reservoir facilities in Project reservoirs where indicated to increase downstream fish survival. Safe and timely downstream passage of juvenile Chinook salmon and juvenile and kelt steelhead is a critical component to the success of the Outplant Program. In order to restore access to historical habitat above Project dams, and address the spatial distribution VSP parameter, the juvenile fish produced from adults released above the dams need to safely pass through reservoirs and dams on their

downstream migration. Sustainable production above the dams would improve productivity and abundance of populations by increasing the total available habitat while limiting dam-related losses. Providing access will also benefit critical habitat because lack of access was a limiting factor.

4.10 **Assess Downstream Juvenile[30] Fish Passage through Reservoirs: The Action Agencies will, in coordination with and review by the Services, assess juvenile fish passage through the following Project reservoirs:**

1. **Cougar**
2. **Lookout Point and Dexter**
3. **Detroit and Big Cliff**
4. **Green Peter and Foster**
5. **Fall Creek**
6. **Hills Creek**

These evaluations will be developed consistent with the RM&E process described below in RPA measure 9 (RM&E). The Action Agencies must seek NMFS' review of evaluation proposals. Comments submitted by NMFS on draft evaluation proposals must be reconciled by the Action Agencies in writing to NMFS' satisfaction prior to initiating any research-related activities anticipated in this RPA.[31] The proposals must identify annual anticipated incidental take levels by species, life stage, and origin[32] for each year. The Services will inform the Action Agencies whether they agree[33] with the proposed studies, reports, and NEPA alternatives. The Action Agencies will begin these studies in 2008; field investigations, study reports, and NEPA analyses, if necessary, will be completed by December 31, 2015.

Rationale/Effect of RPA 4.10: Juvenile fish (and kelts) need to emigrate through reservoirs, or be transported around them, in order to continue their downstream migration and complete their life cycles. Effects are unique at each reservoir: fish may pass satisfactorily through some reservoirs, but have problems, such as loss by predation or residualism (failure to continue migrating) at others. For instance, preliminary results at Fall Creek and Cougar indicated juvenile Chinook salmon were able to safely migrate through the reservoirs, yet studies at Green Peter in the 1980s showed few fish released near the head of the reservoir reached the dam.

There is little information on fish use, migration rates, and survival in the Willamette Project reservoirs.[34] Most of the information on Project reservoir fish passage has been

[30] Include downstream steelhead kelt passage in Santiam studies through Detroit, Big Cliff, Green Peter, and Foster.
[31] See RPA 1.3 & 1.4 for elaboration of decision making process.
[32] That is, hatchery-origin or non-hatchery origin fish.
[33] See RPA 1.3 & 1.4 for elaboration of decision making process.

[34] This RPA does not include small reservoirs such as at Minto and those with the Long Tom dams.

inferred from fish traps placed below reservoirs. The kinds of studies that are needed would vary among reservoirs, depending on existing information and characteristics of each reservoir and the species that use it. If studies show that fry use a reservoir for rearing before migrating downstream as juveniles or smolts, then juvenile collection facilities at or near the face of the dam would be preferred over head-of-reservoir collection facilities. On the other hand, if juvenile fish are exposed to heavy predation while in the reservoir, then efforts would need to be directed at either head-of-reservoir collection, reducing predators or predator habitat, or reservoir operations that would encourage juvenile fish to quickly migrate downstream. In large reservoirs, currents may also be found to influence juvenile migration (vertical and horizontal distribution through the reservoir), and fish collection facilities would need to be located to take advantage of such currents. These examples show that downstream fish passage decisions regarding alternative operational and facility designs must be based on site-specific data regarding passage through reservoirs. Without this information, downstream passage facilities could be ineffective due to poorly located facilities or lack of understanding of reservoir use.

The effect of this measure will be to provide site-specific information regarding juvenile fish passage and use of Project reservoirs, informing key decisions related to downstream fish passage facilities and reservoir operations, and possibly predator management. Improved downstream fish passage will ultimately increase spatial distribution by providing safe access to and from historical habitat. This will, in turn, increase numbers of listed fish, which is needed to address the effects of the Project (depressed abundance and productivity).

4.11 **<u>Assess Downstream Juvenile Fish Passage through Dams:</u> At Cougar, Lookout Point and Dexter, Detroit and Big Cliff; Foster and Green Peter, Fall Creek, and Hills Creek dams, the Action Agencies will, in coordination with and review[35] by the Services, do the following:**

1. **Assess passage survival and efficiency through all available downstream routes, including turbines, spillways, regulating outlets, hatchery water supplies, etc., noting injury and mortality through each route.**
2. **Identify and propose alternatives for reducing juvenile mortality passing through the routes noted above, including, but not limited to, operational and structural modifications.**
3. **The Action Agencies will begin these studies in 2008 and will complete all field investigations, study reports, and NEPA analyses, if necessary, by December 31, 2015 (except as noted below for Cougar, Lookout Point, and Detroit in RPA measure 4.12, which have earlier completion dates).**
4. **These evaluations will be developed consistent with the RM&E process described below in RPA measure 9. The Action Agencies must seek NMFS' review of evaluation proposals. Comments submitted by NMFS on draft**

[35] See RPA 1.3 & 1.4 for elaboration of decision making process.

evaluation proposals must be reconciled by the Action Agencies in writing to NMFS' satisfaction prior to initiating any research-related activities anticipated in this RPA. The proposals must identify anticipated take levels of each species and life stage for each year. The Services will inform the Action Agencies whether they agree with the proposed studies, draft reports, and alternatives.

5. **The Action Agencies will conduct additional studies in anticipation of additional passage measures constructed and operated beyond 2023.**

Rationale/Effect of RPA 4.11: The effect of lack of effective downstream fish passage facilities is described in the Effects sections for the major subbasins with Project dams (Middle Fork Willamette, section 5.2; McKenzie, section 5.3; South Santiam, section 5.5; and North Santiam, section 5.6). However, there is little existing information on downstream fish passage through various routes at Project dams. Studies are needed to determine the proportion of fish moving through existing outlets (turbines, regulating outlets, spillways, sluiceways), and their survival and injury rates through each outlet. In order to determine the likely effectiveness of downstream fish passage alternatives, studies are needed to evaluate vertical and horizontal distribution of fish as they reach the face of the dam, and to evaluate biological, technical and engineering issues associated with design of passage facilities.

The information is key to designing effective passage facilities. The kinds of studies that are needed would vary among dams, depending on existing information and characteristics of each dam and the species that use it. The focus of studies would be to develop and evaluate alternative fish passage concepts that would guide site-specific decisions and identify priorities among Project dams on the most effective downstream passage methods at each dam where it is deemed feasible and likely to be effective. If studies show that fry use a reservoir for rearing before migrating downstream as juveniles or smolts, then juvenile collection facilities.

The effect of this RPA will be to provide site-specific information regarding downstream fish passage at Project dams, informing key decisions related to downstream fish passage facilities. This information is a necessary first step in fish passage design. Improved downstream fish passage will ultimately increase spatial distribution by providing safe access to and from historical habitat.

4.12 **<u>Long-Term Fish Passage Solutions</u>: Based on the best available scientific information at the time of development of this RPA, additional structural and operational modifications are needed to allow safe fish passage and access to habitat above and below Willamette project dams.**

The Action Agencies will complete this work as part of the COP described in RPA measure 4.13 below and according to the schedule in Figure 9.4-1. The dates for completing interim steps are guidance. However, the dates for completion and operation are fixed. Measures 4.12.1 through 4.12.3 identify dates for making

structural modifications (or biologically equivalent operational measures), based on the best available information at the time of development of the RPA.

These structural or operational modifications will be analyzed and developed as high priority measures in the Willamette Configuration Operation Plan (COP) (see RPA measure 4.13). The COP will evaluate a range of structural and operational alternatives for improving fish passage and water quality conditions associated with the Willamette dams. The three alternatives described below in RPA measures 4.12.1, 4.12.2 and 4.12 .3 will be priority actions evaluated in the COP to determine whether they are biologically and technically feasible. The Action Agencies, FWS, and NMFS will evaluate the information gathered through the COP, NEPA, RM&E measures, and any other sources of information such as ESA recovery planning (including life cycle modeling developed as part of the recovery planning process), university studies, local monitoring efforts and public comment, to determine whether the scheduled action, or an alternative, will provide the most cost-effective means to achieve benefits to ESA-listed fish. If the information gathered confirms that the scheduled action is best suited to addressing the effects of the Project, the Action Agencies will proceed with implementation. If the information shows that an alternative action would provide similar biological benefits, is technically feasible, and would be more cost-effective, then the Action Agencies will implement the alternative action.[36] The Action Agencies may need to complete appropriate NEPA analyses and obtain authorization and appropriation before implementation. The Action Agencies will present specific implementation plans to NMFS, and NMFS will evaluate whether the actions proposed in the implementation plans meet the biological results NMFS relied on in its 2008 biological opinion. NMFS will notify the Action Agencies as to whether the proposal is consistent with the analysis in the biological opinion.

The Action Agencies will analyze additional structural and operational measures for downstream fish passage (beyond the three listed in measures 4.12.1 through 4.12.3 below) as part of the COP. The measures will be investigated in the same manner as for the three measures listed below. The time frame for construction and operation of these additional passage measures may extend beyond the time frame of this Opinion. However, the Action Agencies must begin certain actions, such as investigating feasibility, completing plans, conducting NEPA, if necessary, and requesting authorization, during the term of this Opinion. These studies will be included in the COP.

[36] See RPA 1.3 & 1.4 for elaboration of decision making process.

Figure 9.4-1 Willamette Project Implementation Schedule. Revised Gantt chart from the Action Agencies (USACE 2008a).

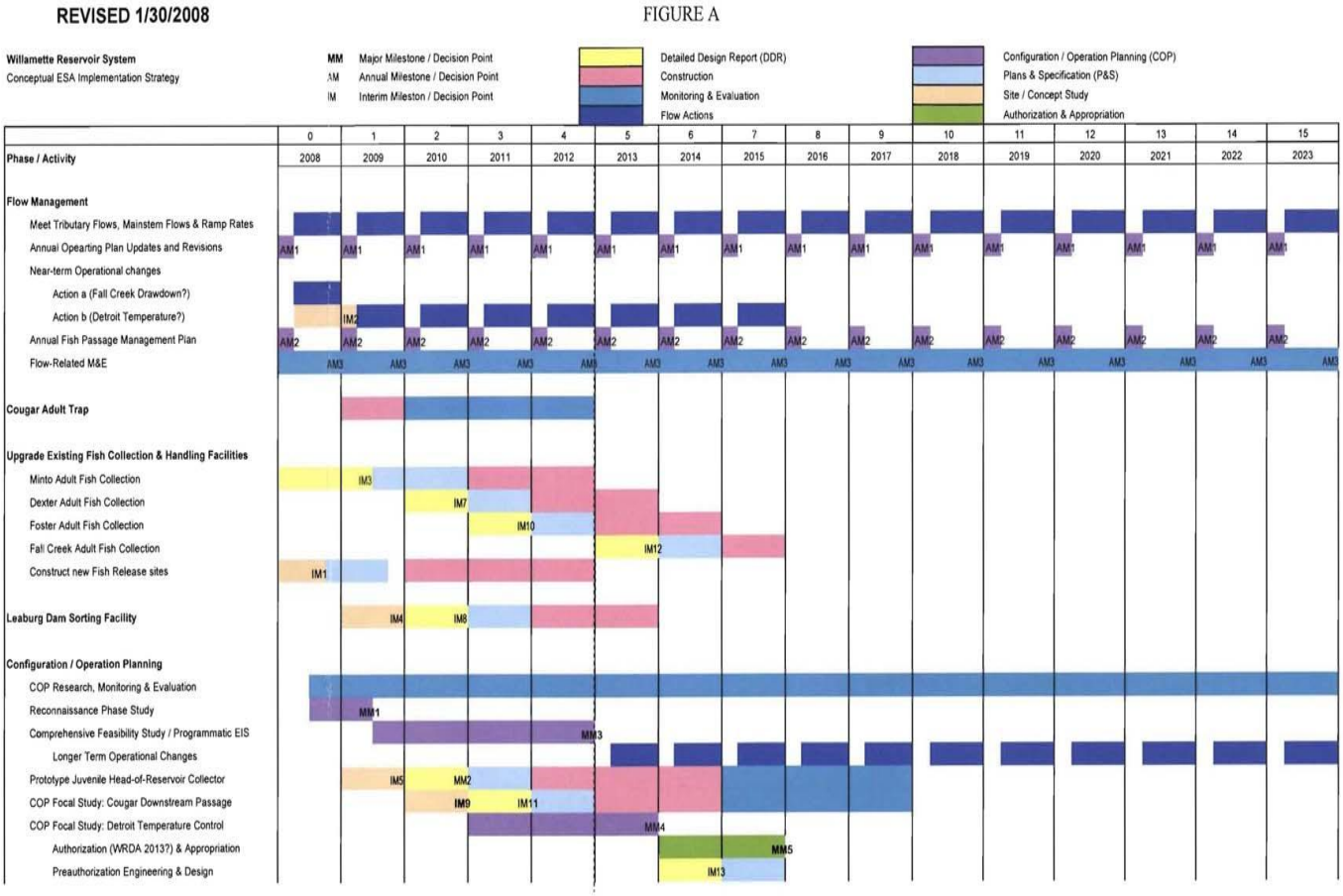

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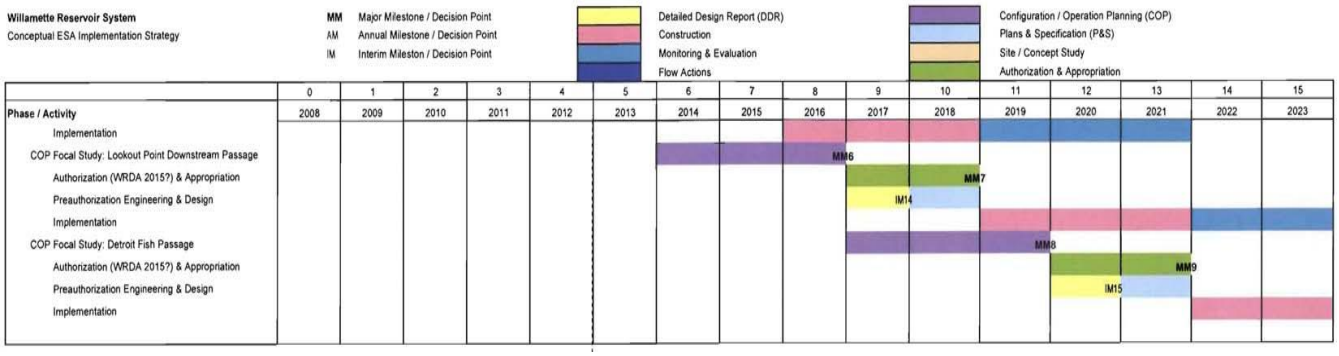
FIGURE A



***Rationale/Effect of RPA 4.12*:** This measure ensures that three major fish passage actions will be taken by the Action Agencies by specified dates. As stated elsewhere in this Opinion, lack of passage is the most significant limiting factor to the viability of the affected populations of UWR Chinook salmon and UWR steelhead. This measure addresses that effect of the PA.

NMFS chose the three sites listed in the RPA for the first three passage facilities, based on the best available information at the time of this Opinion. The choice of location of the passage facility, as well as the method of passage may change based on additional information. If information shows a different location or passage method, then the Action Agencies must coordinate with the FPHM and receive NMFS' agreement on the proposed change. Also, passage methods may vary based on the specific requirements needed at each site, as well as how the fish behave at that location.

These three passage facilities are not all that the Action Agencies will ever need to construct to address access limitation, but are sufficient in the next 15 years to begin to address the effects of the Project. By improving downstream fish passage at Cougar, Lookout Point, and Detroit dams, survival will increase for three of the four UWR Chinook populations (McKenzie, Middle Fork, and N. Santiam) and one of the two UWR steelhead populations (N. Santiam) directly affected by Project dams. However, the Action Agencies need to continue studying the next location for passage during the next 15 years so they are ready to construct and operate the next facility soon after completion of the term of this Opinion, and possibly the next one after that. Additionally, measures in an RPA must be within the Action Agencies' ability to implement. The pace of completion of passage measures is as fast as the Action Agencies can proceed.

NMFS recognizes that where fish passage was not previously authorized, the Action Agencies may need to complete appropriate NEPA analyses and obtain congressional authorization before implementation. Further, regardless of whether fish passage was previously authorized, the Action Agencies will need to obtain appropriations before project construction activities can begin.

The effect of this measure will be to ensure that passage happens at three locations within the next 15 years. This will greatly help increase numbers of UWR Chinook salmon and steelhead because they will have access to upstream habitat, and the juveniles will have access downstream to the ocean for growth to maturity. With respect to critical habitat, this measure will address the Habitat Access pathway by improving access past physical barriers, and thereby improving the status of PCEs for spawning, rearing, and migration of UWR Chinook salmon and UWR steelhead populations.

Improved downstream fish passage with will also benefit critical habitat because lack of migration corridor access was a limiting factor.

4.12.1 **Cougar Dam Downstream Passage: The Action Agencies will investigate the feasibility of improving downstream fish passage at Cougar Dam through structural modifications as well as with operational alternatives, and if found feasible they will construct and operate the downstream fish passage facility.**

- **The Action Agencies will take necessary initial steps beginning no later than 2010, which may include a site/concept study, design report, plans and specifications, if appropriate.**
- **The Action Agencies will establish a Major Milestone (MM2) (described in measure 4.13 below) near the end of 2010, in conjunction with completion of the Cougar Site/Concept Study and DDR. The Action Agencies will make "go/no go" decisions on the feasibility of Cougar downstream passage facilities. In the case of the decision to move forward on implementation, the decision will potentially be focused on alternative locations and designs for downstream passage facilities and operations. (NMFS assumes that fish passage improvements at Cougar Dam will not require further authorization because passage was specifically authorized and constructed as part of the original Cougar Dam plans[37]; NMFS also assumes that the proposed Cougar trap will be used for upstream fish passage.)**
- **The Action Agencies will complete construction of any structural fish passage facilities by Dec. 2014; and by 2015, begin operating downstream fish passage facilities at Cougar Dam. Any necessary NEPA compliance required for implementation of the proposed facilities will occur in conjunction with development of the DDR.**

Rationale/Effect of RPA 4.12.1-Cougar Downstream: The Proposed Action identifies a series of field studies, alternatives analyses, and reports that will be completed, if funding is available, to assess the feasibility of downstream fish passage facilities at Cougar Dam and other Project dams, however, the Action Agencies provide no certainty that fish passage improvements will be made. As noted in Section 5.3, McKenzie Subbasin Effects, lack of access to historical spawning and rearing habitat above Cougar Dam is one of the limiting factors affecting population numbers and spatial distribution for the McKenzie Chinook salmon population. This population is at "moderate risk" of extinction and is considered a "core" and "genetic legacy" population (McElhany et al. 2007). Efforts to increase the viability of this population are essential, because it has the potential to be the stronghold for the ESU and is therefore likely to be targeted for "high" or "very high viability" in the recovery plan.

In addition to the population's status within the ESU, NMFS considers achieving safe fish passage at Cougar Dam a priority because this dam was originally authorized for fish passage, presumably making it easier for the Action Agencies to request and receive funding for this purpose. Cougar Dam originally incorporated fish passage measures, but these were abandoned due to the Project's effect on downstream water temperatures that

[37] Due to temperature changes caused by construction of the reservoir, original passage efforts failed. Since 2005, however, temperature problems have been largely solved, and passage is once again feasible.

inhibited returning adults from reaching and entering a trap at the base of the dam. Cougar Dam was upgraded in 2005 with new temperature control facilities which now make, for the first time in 40 years, collection of adults feasible below the dam. USACE plans to construct a new adult fish trap at the base of Cougar Dam in 2009. Once adults are captured in the new trap and transported above the dam, their juvenile progeny will need to emigrate out to complete their life cycles, hence the need for downstream passage at Cougar.

The effect of this measure will be to provide improved downstream fish passage at Cougar Dam, increasing spatial distribution by providing safe access to and from historical habitat. By addressing the primary impediment to population growth and spatial distribution for the McKenzie Chinook salmon population, this measure will support increased abundance and productivity of this core population, reducing the likelihood that the Proposed Action will cause jeopardy.

With respect to critical habitat, this measure will address the Habitat Access pathway by improving access past a physical barrier, and thereby improve the status of PCEs for spawning, rearing, and migration of the McKenzie Chinook salmon population.

4.12.2 **Lookout Point Dam Downstream Passage: The Action Agencies will investigate the feasibility of improving downstream fish passage at Lookout Point Dam, and if found feasible, they will construct and operate downstream fish passage facilities there. The Action Agencies will take necessary initial steps, beginning no later than 2012, which may include feasibility studies, a design report, authorization and appropriation, and plans and specifications, if appropriate.**

- **The Action Agencies will complete construction of any structural fish passage facilities by December 2021.**
- **By March 2022, the Action Agencies will begin operating downstream fish passage facilities at Lookout Point that will enable collection and transport of fish from above Lookout Point to habitat downstream of Dexter.**
- **The Action Agencies will establish a Major Milestone (MM6) near the end of 2014 in conjunction with completion of the Lookout Point Feasibility Study. The major decision associated with that milestone will be "go/no go" decisions on the feasibility of Lookout Point fish passage facilities. Another Major Milestone (MM7) may be needed near the end of 2016 pending actions on authorization and appropriation of proposed facilities.**

Rationale/Effect of RPA 4.12.2: The Proposed Action identifies a series of field studies, alternatives analyses, and reports that would be completed, if funding is available, to assess the feasibility of downstream fish passage facilities at Lookout Point and Dexter dams, however, the Action Agencies provide no certainty that fish passage improvements will be made. As noted in Section 5.2, Middle Fork Willamette Subbasin Effects, lack of access to historical spawning and rearing habitat above Project dams restricts spatial distribution for the Middle Fork Willamette population to a few miles of habitat below

Dexter Dam that is unsuitable for spawning and juvenile fish production due to Project effects on downstream water temperature and habitat complexity. This restricted spatial distribution is likely the most important factor limiting abundance and productivity of the Middle Fork Willamette Chinook salmon population, and without significant improvements in spatial distribution this population may be lost. Improvements to the fish collection facility at Dexter will address the upstream component of habitat access, but safe downstream fish passage past Lookout Point and Dexter is essential to ensure that the Outplant Program can successfully reestablish fish production above these dams.

The effect of this measure will be to provide improved downstream fish passage past Lookout Point and Dexter dams, increasing spatial distribution by providing safe access to and from historical habitat. By addressing the primary impediment to spatial distribution for the Middle Fork Willamette Chinook salmon population, this RPA will support increased abundance and productivity of this population, increasing the likelihood that this population will trend toward a "viable" status rather than be lost. As a result, by protecting and restoring this population, there is reduced risk that the Proposed Action will cause jeopardy to the UWR Chinook salmon ESU.

With respect to critical habitat, this RPA will address the Habitat Access pathway by improving access past a physical barrier, and thereby improve the status of PCEs for spawning, rearing, and migration of the Middle Fork Willamette Chinook salmon population.

4.12.3 **Detroit Dam Downstream Passage: The Action Agencies will investigate the feasibility of improving downstream fish passage at Detroit Dam and if found feasible they will construct and operate downstream passage facilities. Temperature control will also be considered in designing the passage facility.**

- **The Action Agencies will take necessary initial steps beginning no later than 2015, which may include feasibility studies, a design report, authorization and appropriation, and plans and specifications, if appropriate.**
- **The Action Agencies will establish a Major Milestone (MM8) near the end of 2017 in conjunction with completion of the Feasibility Study. The major decision associated with that milestone will be "go/no go" on the feasibility of fish passage facilities at Detroit Dam. Another Major Milestone (MM9) may be needed near the end of 2019 pending actions on authorization and appropriation of proposed facilities.**
- **The Action Agencies will complete construction of any structural fish passage facilities by December 2023. (This measure may be completed earlier in conjunction with Detroit temperature control efforts, as described in RPA measure 5.2 below).**
- **By March 2024, the Action Agencies will begin operating downstream fish passage facilities at Detroit that would enable collection and transport of fish from above Detroit to habitat downstream of Big Cliff Dam. Any necessary**

NEPA compliance required for implementation of proposed facilities will occur in conjunction with preparation of the Feasibility Report.

Rationale/Effect of RPA 4.12.3: The Proposed Action identifies a series of field studies, alternatives analyses, and reports that would be completed, if funding is available, to assess the feasibility of downstream fish passage facilities at Detroit and Big Cliff dams, however, the Action Agencies provide no certainty that fish passage improvements will be made. As noted in Section 5.6, North Santiam Subbasin Effects, lack of access to historical spawning and rearing habitat above Project dams restricts spatial distribution for the North Santiam populations of Chinook salmon and steelhead to habitat below Big Cliff Dam. This downstream habitat is degraded by ongoing Project operations that continue to interrupt sediment transport, alter downstream water temperatures, and modify the rate and seasonality of downstream flows. Rebuilding the fish collection facility at Minto Dam below Big Cliff Dam will address the upstream component of habitat access, but downstream passage facilities are entirely lacking. Safe downstream fish passage past Detroit and Big Cliff is essential to ensure that the Outplant Program can successfully reestablish fish production above these dams.

Although NMFS has given a lower priority to this downstream passage facility than for similar facilities at Cougar and Lookout Point/Dexter dams, NMFS would prefer that this RPA be completed earlier than 2023. As described below in RPA measure 5.2, Water Quality, water temperature control facilities at Detroit Dam are scheduled to be constructed by 2018. These two measures should be evaluated and designed concurrently to ensure the design for temperature control does not preclude viable options for downstream passage. Moreover, the Action Agencies would likely achieve cost-savings and reduce operational and environmental adverse effects of construction by planning and constructing both facilities at the same time.

The effect of this measure will be to provide improved downstream fish passage past Detroit and Big Cliff dams, increasing spatial distribution by providing safe access to and from historical habitat. By addressing the primary impediment to spatial distribution for the North Santiam populations of Chinook salmon and steelhead, this RPA will support increased abundance and productivity, increasing the likelihood that these populations will trend toward a "viable" status. As a result, by protecting and restoring this population, there is reduced risk that the Proposed Action will cause jeopardy to the UWR Chinook salmon and UWR steelhead ESUs.

With respect to critical habitat, this RPA will address the Habitat Access pathway by improving access past a physical barrier, and thereby improve the status of PCEs for spawning, rearing, and migration of the North Santiam populations of Chinook salmon and steelhead.

4.13 **<u>Willamette Configuration Operation Plan (COP)</u>: The Action Agencies will carry out the COP, a multi-year, multi-level study process, to evaluate a range of potentially beneficial actions for listed fish species at Project dams and reservoirs. Figure 9.4-1 identifies specific measures, studies, and milestones that will be**

accomplished through the COP. The interim steps will be completed in a timely manner; however, the dates shown in Figure 9.4-1 for interim steps are not firm. Regardless of the timing of interim steps, the Action Agencies will complete each Project measure no later than the final date listed for each measure. The Action Agencies will keep the Services appraised of their progress.

The Action Agencies will evaluate in the COP a variety of potential actions intended to benefit ESA-listed fish, including but not limited to, the following measures:

- **Upstream fish passage facilities, other than the collection facilities described in RPA measure 4.6, above;**
- **Adult fish release sites that require detailed study, as described in RPA measure 4.7, above;**
- **Interim operations for downstream fish passage that require detailed study, as described in RPA measure 4.8, above;**
- **Head-of-reservoir juvenile collection facilities that require detailed study, as described in RPA measure 4.9, above;**
- **Downstream passage facilities or operations, as described in RPA measure 4.12, above;**
- **Temperature control facilities or operations, described in RPA measure 5.2, below;**
- **Interim operations for temperature control that require detailed study, described in RPA measure 5.1, below; and**
- **System-wide operational changes, including "balancing" reservoir refill and release rates, to meet tributary and mainstem flow targets, as described in RPA measure 2.4, above.**

1. ***Definition of Milestones:*** **The COP and related actions will rely on a series of established milestones at key decision points at which the Action Agencies will coordinate and review key decisions with the Services. There will also be regular, continuous coordination between the Action Agencies, NMFS, USFWS, and other affected agencies and Tribes through the WATER process throughout implementation of proposed measures.**

There are three types of milestones identified in this RPA and defined below:

<u>Annual Milestones (AM)</u> for interagency coordination of annual and recurring activities associated with planning and implementation of ongoing ESA Measures related to operations, including completion of annual Willamette Fish Operations Plan (WFOP) revisions, and annual review of research, monitoring and evaluation (RM&E) results.

<u>Interim Milestones (IM)</u> for interim decision points in the planning and development of specific actions, including completion of site/concept studies, detailed design reports, and other key steps in the decision-making process. Interim

Milestones will include decision points on the scope, scale, and location of ESA measures under consideration with NMFS and USFWS review and comment.

Major Milestones (MM) are forecasted key points in the planning, design and implementation process involving decisions on the feasibility of major elements of the RPA and Proposed Action. They may include "go/no go" decisions on implementation of proposed major structural elements, such as fish passage or temperature control facilities, and/or significant operational changes. They may also involve decisions to shift efforts to different alternatives or priorities. Depending on decisions reached regarding the feasibility of proposed measures, it may be necessary to identify other alternatives or reinitiate ESA Section 7 consultation as a result of new information produced through the COP and related studies and coordinated through the Major Milestones.

2. ***Research, Monitoring and Evaluation:*** **RM&E will be a substantial component of the COP. The focus will be on collection and evaluation of biological and physical information required to determine the feasibility of alternative structural and operational measures under consideration in interim and major milestones. The COP RM&E program will be initiated in FY 08 and continue through the term of the Opinion. The Action Agencies will conduct an Annual Review of the Willamette COP and other related RM&E programs to review the results from previous years and revise RM&E program for upcoming years.**

3. ***Reconnaissance Phase Study:*** **The Action Agencies will initiate Phase I of the COP, the Reconnaissance Study (USACE 2007a, Section 3.6.4.3) by September 2008 and complete it by October 2009. The Reconnaissance Report will identify the range of structural and operational alternatives to be evaluated, establish preliminary basin priorities, define biological and other criteria to be used in evaluating alternatives, and provide the detailed Statement of Work for the COP Feasibility Phase. The Action Agencies will establish a Major Milestone (MM1) at the completion of the Reconnaissance Report. The primary purpose of this milestone will be to seek interagency review and concurrence on the scope and content of the subsequent Feasibility Phases. One of the key decision points at this milestone will be to review and possibly refine the priority of long term fish passage and water quality solutions for the COP (described in RPA measures 4.12 and 5.2, respectively).**

4. ***Comprehensive Feasibility Study:*** **The Action Agencies will initiate the Comprehensive Feasibility Study (USACE 2007a, Section 3.6.4.4) by October 2009 and will complete it by September 2012. The Comprehensive Feasibility Study will consider and incorporate relevant results of any life-cycle modeling developed as part of the Upper Willamette recovery planning process. If needed, the Action Agencies will complete appropriate NEPA coverage addressing the range of structural and operational alternatives addressed as part of the COP Comprehensive Study Phase. The Feasibility Report will reflect Action Agency preliminary determinations regarding the feasibility of fish passage, temperature control and other related structural and operational alternatives in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette basins. It is expected to provide specific recommendations for improvements to highest**

priority subbasins and/or features and to include recommendations for major operational changes. It will also evaluate the "high priority actions" (long term fish passage and water quality solutions described in RPA measures 4.12 and 5.2, respectively), and may suggest modifying the scope or timelines of these "high priority actions" based on the outcome of RM&E efforts.

The Action Agencies will establish a major milestone (MM3) at the completion of the COP Comprehensive Feasibility Study. At this point the Action Agencies will have completed initial studies and evaluations on a number of major alternatives, including prototype head-of-reservoir fish collection, downstream passage at Cougar Dam, and temperature control at Detroit Dam. The key decisions at this milestone are whether or not to continue toward fish passage and temperature control modifications of the dams as described in RPA measures 4.12 and 5.2, to evaluate whether or not the correct priorities were established for these measures 4.12 and 5.2, and whether other alternatives are determined more feasible. If the downstream fish passage improvements at Cougar Dam and other locations are determined not likely to be feasible at this milestone, then the Action Agencies may identify other alternatives that would be implemented within the same timelines as those identified in this RPA, or agree to reinitiate Section 7 consultation.

The Action Agencies will present specific implementation plans to NMFS, and NMFS will evaluate whether the actions proposed in the implementation plans are likely to have the biological results that NMFS relied on in this Opinion. NMFS will notify the Action Agencies as to whether the proposal is consistent with the analysis in this Opinion.

Rationale/Effect of RPA 4.13: Section 3.6.4 of the Supplemental BA (USACE 2007a) describes the Willamette System Review Study, the Action Agencies' proposal to undertake a series of studies to evaluate the feasibility and relative benefits of structural and related operational modifications to the Willamette dams designed to improve survival and productivity of ESA-listed aquatic species. The Action Agencies have changed the name of this study framework to "Willamette Configuration /Operation Planning" (COP). The Willamette System Review Study lacked certainty and commitment that fish passage, temperature control, and other improvements would be funded and completed during the term of this Opinion. As a result, the COP is significantly different than the Willamette System Review Study in that it adds certainty to the Action Agencies' proposed study by requiring firm dates for completion of specific measures.

The COP process, and NEPA when appropriate, will outline the costs of the projects, their biological benefits, technical feasibility, potential alternatives, and compliance with all applicable statutes and regulations. The analysis tool of cost effectiveness and incremental cost analysis will be used to assess the range of alternatives. An alternative plan is considered cost effective if it provides a given level of biological benefit for the least cost. Cost effectiveness analysis will be used to identify the least cost solution for each alternative that provides necessary environmental benefit. Incremental cost analysis compares the additional costs to the additional biological benefits of an alternative.

The effect of this RPA will be that the Action Agencies will complete evaluations that they state are needed to move forward on various fish passage, temperature control and other improvement projects and will then move forward with implementation of these measures. This will minimize time lost before fish protective measures are implemented and become effective at improving fish survival and habitat affected by Project facilities. With respect to critical habitat, this RPA will address the Habitat Access pathway by minimizing time lost before access is improved past physical barriers, and thereby will improve the status of PCEs for spawning, rearing, and migration of UWR Chinook salmon and UWR steelhead.

9.5 WATER QUALITY

The RPA measures in this section are based on sections 3.6 and 3.7 of the Supplemental BA (USACE 2007a). In section 3.6, the Action Agencies propose to evaluate the need and opportunities to achieve water temperature control at Project dams as part of the Willamette System Review Study. In section 3.7, the Action Agencies propose to do the following: 1) continue to operate the Cougar WTC to meet downstream water temperature targets; 2) conduct extended RM&E for Cougar WTC; and 3) carry out ongoing and new RM&E for water quality in Project-affected tributaries and the mainstem Willamette River.

NMFS agrees (in McKenzie Effects section 5.3) that continued operation of the Cougar WTC will provide more normative water temperatures in the South Fork McKenzie and mainstem McKenzie rivers, and will continue to support adult spawning, egg incubation, and fry and juvenile rearing for UWR Chinook salmon. While NMFS agrees that extensive RM&E studies are needed at Cougar to evaluate the effectiveness of the WTC and throughout the basin (General Effects, section 5.1) to monitor water quality and determine appropriate courses of action to achieve water quality standards, the Proposed Action does not provide sufficient certainty that these RM&E studies will be sufficient to provide necessary data and guide decision-making. Additionally, while NMFS agrees that further alternatives analysis is needed to identify priorities for implementing temperature control measures at Project dams (General Effects, section 5.1), the Proposed Action does not require any interim temperature control measures nor does it provide certainty that any permanent facilities will be constructed or operations will be carried out. RPA measure 5 is intended to address these issues.

The adverse effects of the Proposed Action on listed fish and critical habitat include unacceptable water temperature and TDG downstream of the Project dams where listed fish are forced to spawn because they have inadequate access to upstream habitat. The Proposed Action also causes adverse effects on critical habitat conditions downstream of the dam for the same reasons listed above. The water quality measures in the RPA will minimize these project-related adverse effects because they will make water temperatures and TDG more similar to natural conditions. The RPA measures will also provide for fish protection when there are emergencies causing the facilities to operate outside their normal procedures.

Some of the measures in this section of the RPA provide interim protection for listed fish and critical habitat by requiring the Action Agencies to implement certain temperature control measures in the next few years. These measures will address immediate needs of listed fish by providing more suitable habitat downstream of certain dams in areas used for spawning. In addition, the emergency protocols and actions will prevent further harm to listed fish and critical habitat by providing measures for listed fish protection the USACE can take immediately when emergencies arise.

RPA 5 Water Quality

5.1 **Interim Water Quality Measures: Until permanent temperature control facilities and water quality improvements are constructed or operations are established, the Action Agencies will evaluate and carry out, where feasible, interim operational measures and use existing conduits such as spillways, regulating outlets, and turbine outlets to achieve some measure of temperature control and reduced TDG exceedances below Project dams, including Detroit/Big Cliff, Green Peter/Foster, Hills Creek, Lookout Point/Dexter, Fall Creek, and Blue River.**

Rationale/Effect of RPA 5.1: Currently, listed fish are generally limited to inadequate habitat below the Project dams. Water quality problems are one of the major limiting factors in this habitat and prevent proper functioning of critical habitat directly below all of the Project dams listed above except Blue River. Therefore, until long term solutions for effective passage above the dams to properly functioning habitat are available, it is very important to make the habitat below the dams usable for listed fish.

This measure is necessary to ensure that short term actions are taken during the first 5 to 10 years of this Opinion until permanent facilities and operations are constructed and operational. Because permanent temperature control facilities such as the Cougar WTC are complex, large, and very expensive construction projects, the Action Agencies cannot build one or more in the initial years of this Opinion. However, because some of the UWR Chinook salmon populations are presently at such low abundance levels and at high risk of extinction, interim measures are needed as soon as possible to avoid further declines in abundance.

The effect of this measure will be that temperatures below one or more Project dams will more closely resemble normative conditions and TDG exceedances will be reduced, resulting in increased survival of juveniles, eggs, and adults over baseline conditions. This increased survival will help to maintain existing low populations of UWR Chinook salmon and UWR steelhead and will lead to increased productivity and abundance of those populations in affected tributaries. These interim measures will also minimize adverse project effects on critical habitat by increasing the value of critical habitat downstream of the dams by modifying temperature.

5.1.1 **Temperature Control at Detroit/Big Cliff Dams: By March 2009, the Action Agencies will complete an evaluation of the feasibility of modifying operations at Detroit/Big Cliff Dams to improve downstream temperature and TDG conditions, with the objective of achieving similar benefits to water temperature below the dams as was attained in 2007. This analysis will build on information developed during the summer 2007 emergency operation at Detroit Dam in which spill volumes were balanced with releases from the regulating outlets to achieve more desirable downstream temperatures during turbine outages.**

The Action Agencies will establish a Major Milestone (MM) to occur by March 2009, when the evaluation of feasibility is completed. If determined feasible, the Action Agencies will begin to implement the proposed operation beginning in Water Year 2009. If implemented, the Action Agencies will conduct monitoring and evaluation studies to determine the effectiveness of the operation and determine whether the operation should continue in future years. This operational alternative is considered a critical component of Configuration/Operation Planning (COP); effectiveness of using operations of existing facilities to achieve desired downstream water quality conditions will be important in future milestone decisions regarding whether or not to pursue structural water quality improvements.

Rationale/Effect of RPA 5.1.1: This measure identifies the initial location for carrying out interim temperature control measures that will address project-related adverse temperature effects on listed anadromous fish and critical habitat in the North Santiam River. Detroit Dam is a high priority for this action because interim temperature control was shown to be possible and effective in 2007, as described in North Santiam Effects section 5.6.

The effect of this measure is as described above in measure 5.1. Improved water temperatures will result in increased egg survival, as well as likely increased survival of adult and juvenile life stages, causing increases in abundance and productivity for both UWR Chinook salmon and steelhead in the North Santiam River. Another effect of this measure is to improve the value of critical habitat by improving temperature in spawning and rearing areas.

5.1.2 **Additional Interim Water Quality Measures: By March 2010, the Action Agencies will identify measures, in addition to those described in RPA measure 5.1.1 above, that they can start implementing in April 2010, if feasible. By April 2010, the Action Agencies will carry out those operational changes that will result in immediate downstream temperature and TDG benefits; and that do not require congressional authorization, detailed environmental review, extensive permitting, and that are within existing physical or structural limitations. Specific interim operational measures will be determined by the Action Agencies, with the advice of and review by the Services.**

Rationale/Effect of RPA 5.1.2: This measure provides for development of interim measures that can be easily identified and carried out at Project dams other than Detroit Dam without detailed analysis, structural modification, or additional authorization. The Action Agencies have not been able to identify such opportunities at other Project dams, but NMFS includes this measure to require the Action Agencies to assess existing gates, outlets, and operations at Project dams to determine if it is possible to mix outflow from turbines, regulating outlets or other valves with spillway flow to achieve improved downstream water temperatures while minimizing TDG exceedances. Lookout Point Dam is a priority for evaluation because monitoring shows extremely high egg mortality for UWR Chinook salmon in the very limited spawning habitat below Dexter Dam (see Middle Fork Willamette Effects section 5.2). Hills Creek Dam is another location that would likely provide immediate improvements in fish spawning and rearing habitat in the Middle Fork Willamette River below the dam downstream to the upper limit of Lookout Point reservoir.

The effect of this measure is that it may result in interim water quality improvements at more than the one or two dams listed in measure 5.1.1 above. This is an initial assessment that may or may not provide interim options, and thus, the effect on abundance and productivity of listed fish, as well as on critical habitat, is uncertain. However, it is included in this RPA because it has potential benefits to listed fish and critical habitat.

5.1.3 **Complex Interim Water Quality Measures: The Action Agencies will evaluate measures that require detailed environmental review, permits, and/or congressional authorization as part of the COP (see RPA measure 4.13 above). The Action Agencies will complete this component of the COP by April 2011, including seeking authorization and completing design or operational implementation plans for those operations that are determined feasible. The Action Agencies will carry out operations that are feasible by May 2011, contingent on funding, issuance of necessary permits and authorization. The Services will comment on the measures and inform the Action Agencies whether they agree[38] with the interim water quality measures.**

Rationale/Effect of RPA 5.1.3: This measure recognizes that some interim water quality improvement alternatives may include facility or operational changes that would require detailed environmental review, permits, or congressional authorization, and therefore, should be evaluated as part of the COP study (measure 4.13). NMFS distinguishes this interim measure from that in measure 5.2 below, which involves more extensive design and cost, and would be considered a more permanent solution. NMFS expects the kinds of measures that would be included here would be proposals to replace valves on regulating outlets or to install automatic controls on spillway gates. These changes are neither

[38] See RPA 1.3 & 1.4 for elaboration of decision making process.

structurally complex nor expensive, though they would likely require more detailed review than the measures contemplated in measure 5.1.2.

The effect of this measure is that interim water quality improvements may be carried out at more Project dams than contemplated in measure 5.1.2, resulting in more populations of UWR Chinook salmon and steelhead that could benefit from improved downstream temperatures and reduced TDG exceedances. However, NMFS cannot consider the effects of this measure on abundance and productivity of listed fish and critical habitat because there is no certainty that any complex interim alternatives will be carried out. However, it is included in this RPA because it has potential benefits to listed fish and critical habitat.

5.1.4 **Monitoring and reporting of interim water quality improvement measures*:* Each year from 2009 through the term of this Opinion, the USACE will monitor and evaluate the effectiveness of interim and permanent water quality improvement measures, and will produce an annual report, by March 1 of the following year, for review and comment by the Water Quality/Temperature committee. The report will include recommendations, if any, to modify project operations to further improve water quality. The Services will comment on the draft report and inform the Action Agencies if they agree[39] with the recommendations.**

5.1.5 **Modifying interim water quality improvement measures: Each year from 2010 through the term of this Opinion, the USACE will carry out modified project operations proposed in the annual reports described above in RPA measure 5.1.4 unless such modifications require detailed analysis and authorization. If such additional analysis is needed, then the Action Agencies will analyze those proposed modifications as part of the COP (see RPA measure 4.13).**

Rationale/Effect of RPAs 5.1.4 & 5.1.5: Measure 5.1.4 ensures that the Action Agencies will monitor the effectiveness of interim water quality improvement measures carried out as a result of measures 5.1.1, 5.1.2, and 5.1.3, and that they will produce an annual report of their findings. Measure 5.1.5 requires the Action Agencies to use results of monitoring studies and annual report conclusions to modify interim water quality improvement measures, if indicated. NMFS recognizes in these measures that changes requiring detailed analysis, funding, or authorization will not be immediately implemented, but instead, must be considered through the COP study process.

The effect of these measures is that monitoring and reporting will give NMFS and the Action Agencies necessary information to modify water quality improvement measures to improve operations that will better protect UWR Chinook salmon and steelhead below Project dams. NMFS cannot consider effects on abundance and

[39] See RPA 1.3 & 1.4 for elaboration of decision making process.

productivity of listed fish and critical habitat because NMFS cannot predict the results of monitoring and subsequent changes that might be determined beneficial for future interim water quality improvement measures. However, it is included in this RPA because it has potential benefits to listed fish and critical habitat.

5.2 **Water Temperature Control Facilities and Operations: During the term of this Opinion, the Action Agencies will make structural modifications or major operational changes for improved water quality to at least one of the Project dams. Based on the best available information at the time of development of the RPA, NMFS identifies Detroit as the highest priority dam for construction of a temperature control structure or operational changes to achieve temperature control.**

The Action Agencies will investigate the feasibility of improving downstream temperatures and reducing TDG exceedances in the North Santiam River for ESA-listed fish species. The Action Agencies will take necessary interim steps beginning no later than 2010, which may include feasibility studies, a design report, authorization and appropriation, and plans and specifications, if appropriate. As part of this effort, the Action Agencies will evaluate alternatives to achieve both temperature control and downstream fish passage. If feasible and more efficient to achieve both purposes through one construction project, the Action Agencies will include downstream fish passage in this effort, rather than delaying it until 2023, as stated in RPA measure 4.12.3, Detroit Dam downstream passage. The Action Agencies will complete construction of any structural temperature control facilities by December 2018. By March 2019, the Action Agencies will begin operation of permanent downstream temperature control at Detroit Dam.

The Action Agencies will establish a Major Milestone (MM4) near the end of 2011 in conjunction with completion of the Detroit Feasibility Study. The major decision associated with that milestone will be "go/no go" on the feasibility of temperature control facilities. Because temperature control was not included as part of the original project authorization, NMFS assumes that construction of temperature control facilities at Detroit Dam may require Congressional action. Another Major Milestone (MM5) may be needed near the end of 2012 pending congressional action on authorization and appropriation of proposed facilities.

Rationale/Effect of RPA 5.2: This measure builds on the Proposed Action (section 3.6 of the Supplemental BA [USACE 2007a]), in which the Action Agencies propose to evaluate water temperature control at Project dams as part of the Willamette System Review Study. However, the Proposed Action lacks certainty that any temperature control facilities or operations would be provided during the term of this Opinion. This measure provides needed specificity and certainty by identifying a location and date certain when construction will be complete and when improved downstream temperature conditions and reduced TDG exceedances will be achieved.

NMFS chose Detroit Dam as a highest priority for water quality improvements for several reasons. First, past studies by USACE indicate that temperature control is achievable with existing storage capacity at Detroit Dam (see North Santiam Effects section 5.6.3). Second, water quality improvements in the North Santiam would benefit both UWR Chinook salmon and steelhead. Third, UWR steelhead in the North Santiam River are especially dependent on spawning habitat just below Big Cliff Dam and are more likely to be harmed by adverse water temperature conditions and TDG exceedances than steelhead in the South Santiam, which are not as confined to spawning habitat below Foster Dam. Finally, interim operations at Detroit in 2007 confirmed that restoring a more normative water temperature regime caused beneficial effects on downstream fish populations.

The effect of this measure will be that temperatures below Detroit Dam will more closely resemble normative conditions and TDG exceedances will be reduced, resulting in increased survival of juveniles, eggs, and adults over baseline conditions. This increased survival will help to increase productivity and abundance of North Santiam populations of UWR Chinook salmon and UWR steelhead. These more normative temperatures and TDG will also benefit critical habitat because they will make it more useful for listed fish.

5.3 **<u>Protecting Water Quality during Emergency and Unusual Events or Conditions</u>: The Action Agencies will apply protocols developed under RPA measure 4.3 and take actions within existing operational and structural capabilities at all project dams and reservoirs to protect water quality during unusual events and conditions.**

5.3.1 Where the protocols described in RPA measure 4.3 above cannot ensure adequate protection of water quality and other impacts to ESA-listed fish during unusual events/conditions, the USACE will identify structural or mechanical changes that could be made at project facilities for this purpose. The USACE will produce a draft report by September 1, 2009, proposing to make structural or mechanical changes to protect water quality during anomalous events.

5.3.2 With review and comment by the WATER Water Quality/Temperature committee, the USACE will produce a final report by January 1, 2010. NMFS and FWS will inform the USACE if the report's recommendations are inconsistent with this RPA.

5.3.3 The Action Agencies will begin to carry out structural and mechanical changes that will protect water quality during anomalous events and that do not require congressional authorization, detailed environmental review, or extensive permitting by March 1, 2010. These minor changes include only those that meet all of the following criteria: no need to prepare an EIS pursuant to NEPA; no need to obtain additional congressional authorization; no need to submit to extensive permitting procedures; and within reasonable cost.

5.3.4 The Action Agencies will evaluate those measures that require detailed environmental review, permits, and congressional authorization as part of the COP (see measure 4.13). The Action Agencies will complete this component of the COP by April 2011, including seeking authorization and completing design for those structural measures that are determined feasible. The Action Agencies will begin to construct and operate those measures determined feasible by May 2011, contingent on funding and issuance of necessary permits. The Services will inform the Action Agencies whether they agree[40] with the structural measures.

5.3.5 As structural and mechanical changes are completed, the USACE will update the protocols described in measure 4.3 above to include any new instructions for operating the modified facilities.

5.3.6 Any structural or mechanical improvements that are carried out will be continued through the term of this Opinion unless the Action Agencies and the Services determine, as more information is obtained, that there is a better way (that is obviously feasible) to operate for water quality.

***Rationale/Effect of RPA 5.3*:** This measure requires the Action Agencies to prepare for emergency and unscheduled events that may alter water quality and cause harm to listed fish in Project reservoirs and downstream habitat. As described in North Santiam Baseline section 4.6 (and Effects section 5.6), a powerhouse fire at Detroit and Big Cliff in 2007 caused rapid increases in TDG below Big Cliff, potentially killing young steelhead alevins (the stage between hatching and leaving the gravel) as they prepared to emerge from redds below that dam. Had protocols been in place that described ways to avoid and minimize harmful effects of emergency conditions on water quality and fish, these actions could have been carried out immediately by Project staff, thereby reducing the number of steelhead alevins that would have been killed.

The effect of this measure will be that actions to minimize fish harm from emergency events will be identified in advance, and will then be carried out as soon as possible after such events occur, resulting in less injury and mortality to listed fish above and below Project dams. Additionally, because this measure requires the Action Agencies to investigate and carry out structural or mechanical changes determined feasible to protect water quality during emergency events, fish losses will be further reduced.

5.4 **<u>Cougar Dam RM&E</u>: The Action Agencies will fund and carry out an extended biological RM&E program associated with the Cougar Dam WTC. The RM&E program will begin in 2011, after completion of the RM&E program included in the previously authorized Cougar Trap project. The RM&E program will evaluate effects of the WTC operation on the downstream ecosystem (including TDG), fish passage through the reservoir, dam, and regulating outlet, and effectiveness of the trap-and-haul program. It will also quantitatively assess biological benefits realized**

[40] See RPA 1.3 & 1.4 for elaboration of decision making process.

from these protective and restorative measures. By September 2010, the Action Agencies will prepare a revised Cougar Dam WTC Monitoring and Evaluation Plan, based on the original plan developed as part of a previous consultation, subject to review and comment by the Services, and consistent with the RM&E process described below in RPA measure 9 (RM&E). The Action Agencies must obtain NMFS' review of the plan prior to initiating any research-related activities anticipated in this RPA. The proposals must identify anticipated take levels of each species and life stage for each year. The Services will inform the Action Agencies whether they agree[41] with the revised plan, proposed studies, draft reports, and NEPA alternatives. The Action Agencies will begin to carry out the extended RM&E program by March 1, 2011.

Rationale/Effect of RPA 5.4: This measure modifies a similar action described in section 3.7.1.2 of the Supplemental BA (USACE 2007a). The Proposed Action does not specify when this RM&E program would begin, or how it would mesh with ongoing monitoring at Cougar Dam. Monitoring the Cougar WTC and associated fish passage at that facility is already required thru at least 2010 as part of the Cougar Trap project, and NMFS completed consultation on that proposed action in 2007 (NMFS 2007a). In this measure, NMFS requires the Action Agencies to continue RM&E at Cougar Dam beginning in 2011 to ensure that studies include a sufficient number of years of data to represent a variety of water year conditions and to include adult return data.

The effect of this measure will be to ensure that decisions regarding temperature control and downstream passage at Cougar Dam and other Project dams are based on reliable biological information. As a result, existing structures will be operated to improve fish survival and new structures will be more likely to provide safe fish passage and favorable water quality conditions for listed fish below Project dams.

9.6 HATCHERIES

The following actions are included in the RPA for Hatcheries. These actions are necessary for reducing short- and long-term risks faced by the Chinook ESU and steelhead DPS, thereby increasing the viability of the affected populations.

RPA 6 Hatcheries

6.1 **The Action Agencies will work cooperatively with the State of Oregon to ensure that Willamette Project hatchery programs are not reducing the viability of listed ESUs/DPSs.**

6.1.1 **Implementation of Hatchery and Genetic Management Plans (Willamette Basin-wide): The Action Agencies will implement the actions described in the Willamette Hatchery and Genetic Management Plans (ODFW 2003, 2004a, 2005a, 2007a, 2008a, 2008b) for spring Chinook, summer steelhead,**

[41] See RPA 1.3 & 1.4 for elaboration of decision making process.

and rainbow trout, after NMFS approval of these plans. Implementation of these actions requires cooperation with the State of Oregon, who partially funds and operates many of the facilities associated with the Hatchery Mitigation Program.

***Rationale/Effect of RPA 6.1.1*:** The HGMPs provide the detailed management plan for each hatchery program throughout the entire life cycle of the fish. Adherence to the HGMP is necessary since the fine details of the hatchery programs are not (and should not be) included in the Supplemental BA.

The effect of this measure will be to reduce and minimize adverse effects of hatchery programs on UWR Chinook and steelhead. There are many specific protocols and guidelines for spawning, raising, and releasing hatchery fish that need to be implemented to be in accordance with best management practices for reducing impacts to ESA-listed stocks.

6.1.2 **Hatchery Facility Improvements (Willamette Basin-wide): The Action Agencies will improve fish collection facilities associated with the hatchery mitigation program; including salmonid ladders, traps, holding, and acclimation facilities associated with hatchery broodstock collection and the outplanting program. Facilities will be rebuilt according to the schedule described in RPA measures 4.6 and 4.7 above.**

Rationale/Effect of RPA 6.1.2: Improving the collection facilities associated with hatchery broodstock collection and the outplanting program of fish above the dams is necessary in order to reduce the handling impacts to listed fish associated with using the existing facilities. The existing facilities were not designed (nor originally intended) to capture and handle listed fish.

The effect of this measure will be to reduce handling stress and mortality to listed salmon and steelhead associated with the collection of fish associated with the outplanting program above the dams and hatchery broodstock collection.

6.1.3 **Mass-marking of Hatchery Releases (Willamette Basin-wide):- The Action Agencies will continue to mark all hatchery fish releases in the Willamette Basin with an adipose fin clip and otolith mark. The Action Agencies will ensure that coded wire tags (or blank tags if appropriate) will be inserted into all hatchery spring Chinook released into the McKenzie Basin, beginning with the 2008-09 smolt releases. The Action Agencies, with the cooperation of the ODFW, will phase in the tagging of all other Chinook releases according to the schedule described in RPA measure 4.13 above, so that the first year of the age-4 return can be detected at the rebuilt facilities. There is no need to wire tag Chinook releases unless infrastructure is in place to detect adult returns.**

***Rationale/Effect of RPA 6.1.3*:** It is necessary to continue to externally mark all hatchery fish releases so that (1) the status of natural-origin and hatchery-origin returns can be determined, (2) the percentage of hatchery fish spawning naturally in the wild can be determined, and (3) so that managers can incorporate natural-origin fish into hatchery broodstocks as appropriate.

The effect of this measure will be to ascertain effects of the hatchery program on the natural-origin population in terms of the percentage of natural-origin fish collected for broodstock and percentage of hatchery fish on the natural spawning grounds.

6.1.4 **Improvements at Leaburg Dam (McKenzie): The Action Agencies will fund the design, construction, and operation[42] of a sorting facility at Leaburg Dam on the McKenzie River to reduce hatchery fish straying into core spring Chinook natural production areas upstream. Modification of the existing facilities, or construction of new ones, is contingent on agreement by the facility owner, Eugene Water & Electric Board (EWEB), and collaboration with EWEB and ODFW. The Action Agencies will establish a Working Group, comprised of representatives from BPA, USACE, NMFS, ODFW, and EWEB, to scope the design and implementation of the sorting facility. The design philosophy for this facility will be that it automatically separates hatchery-origin adults from other fish.[43] If it is not feasible to design the facility with automatic sorting capability, the Action Agencies will seek NMFS' agreement[44] to use an alternative facility design that minimizes harm to UWR Chinook salmon. The Action Agencies will complete construction of the sorting facilities by December 2013, and begin operation in time for the spring Chinook upstream migration beginning in 2014. If an acceptable sorting facility at this site is deemed infeasible by the Working Group and agreed to by NMFS, then the Action Agencies will take alternative actions to reduce hatchery fish straying to less than 10% of the total population spawning in the wild.**

***Rationale/Effect of RPA 6.1.4*:** The McKenzie run of Chinook is a stronghold population and currently produces the highest number of natural-origin fish in the ESU. Significant spawning by hatchery-origin fish (13-36%) in the wild presently occurs and represents substantial risks to population productivity and diversity. It is necessary to reduce the effects of hatchery fish on this population to the lowest extent possible (0-10%) in order to restore this population and to be able to evaluate its sustainability without the continual infusion of hatchery spawners.

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[42] Operation could be partially or completely funded by another entity.
[43] Hatchery-origin fish have had small metal tags implanted in them. These tags may be electronically sensed and the resulting signal used to operate sorting devices. Non-hatchery origin fish do not have these tags and could theoretically be allowed to pass upstream without human intervention, reducing the injury and stress that they experience.
[44] See RPA 1.3 & 1.4 for elaboration of decision making process.

The effect of this measure will be to reduce the natural spawning of hatchery fish in the wild, thereby reducing risks of genetic introgression.

6.1.5 **Management of Hatchery-origin Spring Chinook Upstream of Cougar Dam (McKenzie): The Action Agencies will discontinue releases of all hatchery spring Chinook salmon above Cougar Dam on the South Fork McKenzie River once sufficient numbers of wild fish can be safely collected at the rebuilt Cougar Dam trap and outplanted above the dam. The minimum number of wild fish needed for the outplanting program will be determined by the Fish Passage and Hatchery Management Committee. If insufficient numbers of wild fish (e.g., less than 100 wild fish) are collected at Cougar Dam, then hatchery fish may be used to supplement natural spawning above Cougar Dam, up to a maximum of 50% of the outplanted fish. The FPHM committee will annually update the Willamette Fish Operations Plan with the appropriate number of hatchery-origin fish to be released upstream of Cougar Dam.**

***Rationale/Effect of RPA 6.1.5*:** The continual outplanting of adult hatchery fish above Cougar Dam represents significant productivity and diversity risks to the McKenzie population because offspring from these outplanted fish (i.e. F1 hatchery fish) would be indistinguishable from natural-origin fish in the population. These fish would then spawn naturally in the population, thereby infusing hatchery genes into the wild population. The continual release of hatchery fish upstream of Cougar Dam is inconsistent with RPA measure 6.1.4 and continues to allow hatchery fish to influence the natural-origin population. This measure includes cooperation with the State of Oregon, who partially funds and operates many of the facilities associated with the Hatchery Mitigation Program.

The effect of this measure will be to manage genetic introgression of hatchery fish in the McKenzie population and facilitate local adaptation of a self-sustaining run of spring Chinook upstream of Cougar Dam in the South Fork of the McKenzie.

6.1.6 **Improve Summer Steelhead Release: The Action Agencies, in cooperation with ODFW, will improve the release of hatchery summer steelhead smolts by allowing volitional emigration from the point of release over an extended period of time (e.g., 2-4 weeks) with any non-migrants being removed and not released into free flowing waters below the Projects, to extent possible given constraints on the current infrastructure. When the facilities are reconstructed, the Action Agencies will ensure that any new acclimation facilities allow for this operation.**

***Rationale/Effect of RPA 6.1.6*:** Improving the release protocols for hatchery summer steelhead smolts should reduce the percentage of hatchery fish that residualize and thus interact with listed fish below the dams. Previously

management practices released all of the fish into the river and did not remove fish that were not ready to actively emigrate to the ocean.

The effect of this measure will be to reduce competition and predation of hatchery fish on natural-origin Chinook and steelhead downstream of the dams.

6.1.7 **Reduce Summer Steelhead Recycling in the Santiam Basin: The Action Agencies, in cooperation with ODFW, will stop recycling adult summer steelhead for fishery harvest purposes by September 1st of each year in the North Santiam and South Santiam rivers. The Action Agencies will continue to operate fish collection traps on a weekly basis through October 15th in order to maximize the collection of summer steelhead, to the extent possible with the current facilities. These fish will then be held at the hatchery for spawning, unless determined otherwise by the FPHM committee.**

***Rationale/Effect of RPA 6.1.7*:** Previously, summer steelhead were periodically recycled through the end of October for sport fisheries downstream of the dams. The practice of recycling fish later in the season (i.e. September through October) when fishery effort is low and the fish are nearing spawning time likely increases the number of summer steelhead that spawn in the wild during the fall and winter. Eliminating the recycling program later in the season and removing the summer steelhead that are captured in the traps will decrease the number of naturally-spawning summer steelhead.

The effect of this measure will be to reduce straying and spawning by summer steelhead in listed winter steelhead habitat and reduce competitive interactions between juvenile summer and winter steelhead.

6.1.8 **Adjust Releases of Summer Steelhead in the Santiam Basin: The Action Agencies, in cooperation with ODFW, will reduce the hatchery summer steelhead release in the North Santiam River to 125,000 smolts. To offset this reduction, summer steelhead releases may be increased in one or more of the following subbasins: South Santiam, McKenzie, and Middle Fork Willamette (up to a total of 36,000 fish) to maintain the existing hatchery mitigation in the Willamette Basin. The revised HGMP for summer steelhead will identify how these production changes will be allocated among the different rivers.**

***Rationale/Effect of RPA 6.1.8*:** Recent creel survey data shows the sport fishery in the South Santiam catches more summer steelhead than in the North Santiam (Schroeder et al. 2006). However, more hatchery fish are released in the North Santiam than the South Santiam. The combination of greater hatchery fish released and lower fishery harvest in the North Santiam is leading to widespread spawning by hatchery summer steelhead in the listed winter steelhead habitats. Adjusting the release numbers in the North and South Santiam to be more aligned with current fishery needs, and will allow greater harvest and reduce impacts to winter steelhead.

The effect of this measure will be to reduce spawning of summer steelhead in listed winter steelhead habitat of the North Santiam, thus reducing adverse effects of the hatchery program. More fish released in the South Santiam will provide more harvest in the sport fishery, where fishing effort is greater. Harvest of summer steelhead will likely increase, and thus straying and spawning by summer steelhead should not increase appreciably.

6.1.9 **Future Summer Steelhead Management Actions: The Action Agencies, in cooperation with ODFW, will implement future management actions aimed at reducing the impacts of the summer steelhead hatchery program on ESA-listed species. These actions will be developed according to the process described in section 3.4.10.2 of the Supplemental BA (USACE 2007a), which will incorporate the results of research, monitoring, and evaluation.**

Rationale/Effect of RPA 6.1.9: If RM&E in the near future continues to show unacceptable straying and spawning by summer steelhead in the DPS after recent management changes have been implemented, then further actions to reduce impacts will be developed and implemented as necessary.

The effect of this measure will be to adaptively manage the summer steelhead hatchery program and thus guide future management decisions that could reduce impacts on listed winter steelhead.

6.2 **The Action Agencies will preserve and rebuild genetic resources through conservation and supplementation objectives to reduce extinction risk and promote recovery. These actions rely in part on cooperation with the State of Oregon, which partially funds and operates many of the facilities associated with the Hatchery Mitigation Program.**

6.2.1 **Implementation of Hatchery and Genetic Management Plans (Willamette Basin-wide): When approved by NMFS, the Action Agencies, in cooperation with ODFW, will implement the actions described in the NMFS-approved Willamette HGMPs for spring Chinook, summer steelhead, and rainbow trout.**

***Rationale/Effect of RPA 6.2.1*:** This measure is identical to that described as RPA measure 6.1.1, but is included here because of the importance of HGMPs to practices that rebuild genetic resources.

6.2.2 **Genetically Integrated Management of Spring Chinook Programs (Willamette Basin-wide): For all Willamette spring Chinook hatchery mitigation programs, in each population area (Middle Fork, McKenzie, South Santiam, North Santiam), the Action Agencies, in cooperation with ODFW, will fund and implement conservation and supplementation programs that build genetic diversity using local broodstocks and manage the composition of natural spawners according to the sliding-scale matrices,**

as described in Section 3.4 of the Proposed Action, Supplemental BA (USACE 2007a, and ODFW 2003,2004a, 2005a, 2007a, 2008a, 2008b). The Action Agencies will monitor and evaluate implementation of actions through the end of the ESA take coverage period (term of this Opinion is 15 years).

Rationale/Effect of RPA 6.2.2: Since the hatchery Chinook programs are being used for reintroduction efforts above some of the impassable dams, based upon the best available science, it is necessary for the hatchery stock to be integrated with the natural-origin population to the extent possible at this time. Therefore natural origin fish must be incorporated into the hatchery broodstocks. In addition, hatchery fish will be managed on the spawning grounds to manage genetic risks to the wild population over the long-term.

The effect of this action will be to make the Chinook hatchery stocks as similar as possible to their respective natural-origin counterparts to the extent possible. This will reduce domestication and genetic risks of hatchery fish to the natural-origin population above and below the dams.

6.2.3 **Continue Adult Chinook Outplanting Program (Willamette Basin-wide):- The Action Agencies will continue the existing Adult Chinook Salmon Outplanting program, capturing spring Chinook salmon below USACE projects and transporting them into habitat that is currently inaccessible above the following dams: in the North Santiam, above Detroit Dam; in the South Santiam, above Foster Dam; in the South Fork McKenzie, above Cougar Dam; and in the Middle Fork Willamette, above Lookout Point and Hills Creek dams; and carry out the operational and handling protocols described in the HGMP for each subbasin hatchery. The Action Agencies will use hatchery fish in each population area as described in the HGMP sliding scale matrices. See RPA measures 4.1 through 4.4 of this RPA for additional details.**

***Rationale/Effects of RPA 6.2.3*:** For several Chinook populations (North Santiam, South Santiam, Middle Fork Willamette), it is necessary to use existing hatchery stocks for outplanting efforts above the impassable dams because of the lack of natural-origin fish available. Since the dams blocked most of the historical holding and spawning habitat in these populations and there are problems with water temperature below the Projects, it is necessary to regain production from the areas upstream of the dams, even though hatchery stock will be used for reestablishing the fish above the dams. This measure relies on the Action Agencies working in cooperation with ODFW.

The effect of this measure will be to re-establish natural production in historical habitat above impassable dams. Since the outplanting program has significant impediments at this time with the trapping facilities, prespawning mortality,

downstream passage of juvenile fish through the reservoirs and dams, the use of hatchery fish is more appropriate in many cases than using natural-origin fish.

6.2.4 **Adjust Spring Chinook Release Strategy (Willamette Basin-wide): The Action Agencies will use more natural (i.e. "wild-type") growth rates and size at release for all juvenile spring Chinook reared and released at hatcheries, as feasible. Actions shall be taken to release hatchery fish that are more similar to their natural-origin counterparts to the extent feasible. As proposed in the Supplemental BA, the Action Agencies will work with ODFW to develop a plan for an experimental release in 2009, with an associated RM&E program. The FPHM Committee will evaluate RM&E results, current science on release strategies, and additional information resulting from analysis of previous releases, to develop a plan for modifying future releases. These Chinook hatchery programs serve a dual purpose (fishery augmentation and population conservation), thus consideration shall be given to the survival effects of this hatchery reform action. Unacceptably low survival rates would prevent attainment of both conservation and fishery objectives.**

***Rationale/Effects of RPA 6.2.4*:** Since hatchery Chinook are being used for conservation purposes, it is necessary to align hatchery fish to the extent possible with the natural-origin population. The hatchery fish, when released as smolts, are larger than wild smolts, which has implications for survival, age at return, and reproductive potential. This RPA action will experiment with different release strategies to align hatchery smolts more with wild smolts with the intent of reducing hatchery effects on population viability.

The effect of this measure will be to make the hatchery Chinook more similar to their natural-origin counterparts, thus making them more appropriate for supplementation and reintroduction purposes.

6.2.5 **Molalla River Chinook Recovery: The Action Agencies will support ODFW efforts to eliminate the use of the non-local hatchery Chinook stock (South Santiam) released into the Molalla River. The Action Agencies will work with ODFW to identify potential funding and implementation mechanisms to develop a locally-adapted broodstock, using the conceptual approach described in the hatchery management strategy for the Molalla River Basin.**

***Rationale/Effects of RPA 6.2.5*:** The best available science suggests a locally-derived hatchery stock is better for supplementation purposes than an out-of-population and/or domesticated hatchery stock. The proposed action is to continue to release South Santiam hatchery stock into the Molalla River. Development of a locally derived Chinook broodstock would contribute to recovery efforts in the Molalla River by addressing the effects of the Project.

The effect of this measure will be to reduce impacts of the existing hatchery stock on the population. A locally-derived stock is likely to be more fit to local environmental conditions and more productive.

9.7 HABITAT

This section of the RPA is intended to build upon the measures described in Section 3.5, Habitat Restoration and Management Actions, of the Supplemental BA (USACE 2007a). For the most part, the Proposed Action measures involve assessment of habitat needs and studies to identify and prioritize possible restoration projects, if funding is available. In this Opinion, Section 5, Effects, NMFS describes adverse effects of continued operation of Project dams and maintenance of Project revetments on downstream physical habitat (See Middle Fork Willamette Section 5.2.4; McKenzie Section 5.3.4, etc). The Proposed Action would continue to degrade existing rearing, holding, and spawning habitat below Project dams, reducing abundance and productivity of UWR Chinook salmon and UWR steelhead. Additionally, as described in the Habitat Access and Fish Passage subsections within key tributary sections of Effects (Middle Fork Willamette Section 5.2.1, McKenzie Section 5.3.1, South Santiam Section 5.5.1, and North Santiam Section 5.6.1), the Proposed Action would continue to prevent safe access to historical habitat above the dams, restricting most of the fish to existing habitat below the dams. Thus, during the term of this Opinion, while fish passage solutions are being researched and installed at the highest priority Project dams, the Action Agencies must actively restore habitat downstream of the dams to offset continued degradation in this remaining habitat. Further, as described in Section 3, Rangewide Status, juvenile rearing habitat in the lower reaches of most tributaries is one of the key factors limiting productivity of most populations of UWR Chinook salmon. Even after other limiting factors are addressed that increase productivity (e.g., water temperature and/or fish passage), restoration of juvenile rearing habitat in reaches downstream of the dams will still be necessary to ensure adequate habitat is available for this life stage. Habitat restoration work will prevent further declines in abundance and productivity of UWR Chinook salmon and UWR steelhead associated with Project effects on downstream habitat, and will be necessary to ensure success of other actions required in this RPA by addressing limiting factors associated with other life stages.

7.1 **<u>Willamette River Basin Mitigation and Habitat Restoration</u>: The Action Agencies will plan and carry out habitat restoration programs on off-site lands. Existing programs will continue (7.1.1); a comprehensive program will be established (7.1.2); and additional projects will be done (7.1.3). The purpose of the program will be to protect and restore aquatic habitat to address limiting habitat factors for ESA-listed fish.**

7.1.1 The Action Agencies will continue to carry out the projects listed in Table 9.7-1 (below).

Table 9.7-1 Ongoing Habitat Restoration Projects in the Willamette Basin

Project/Program	Water Body	Description
Willamette Basin Mitigation (BPA 199206800)	Mainstem Willamette	Integrative mitigation program that protects, conserves, and restores areas containing diverse habitats that assist the life history needs and resources for multiple terrestrial and aquatic species in the Willamette Basin.
Delta Ponds (Section 206, USACE)	Mainstem Willamette near Eugene	Construction initiated in 2005 with the City of Eugene, and will continue. The project is providing floodplain and hydraulic connectivity to the Willamette River through a series of old gravel pits.
Springfield Millrace (Section 206, USACE)	Middle Fork Willamette near Springfield	Construction initiated 2008 with the City of Springfield. The project will restore historic millrace and mill pond and creation of wetlands, fish passage and water quality improvements.
North Santiam Gravel Study (Planning Assistance to States, USACE)	North Santiam River	This study was initiated in 2008 and will assess the need and potential locations for gravel placement in the North Santiam River.

7.1.2 The Action Agencies will develop and carry out a comprehensive habitat restoration program, in collaboration with the Services, which will include funding for carrying out habitat restoration projects during the term of this Opinion. The Action Agencies will work with the Services to pursue authorization, if necessary, and appropriations to carry out the habitat restoration program.

The Action Agencies will work closely with the Services to accomplish the following:

1. **Develop project selection criteria aimed specifically at addressing factors limiting the recovery of Willamette basin ESA-listed fish populations, focusing on, but not limited to, those factors caused at least partially by the Willamette Project. These criteria should be informed by regional plans including Willamette Basin Recovery Plans for anadromous salmonids (ODFW 2007b), Willamette Aquatic Habitat Assessment (unpublished, see RPA measure 7.5), Willamette Subbasin Plan (WRI 2004), Willamette River Basin Planning Atlas (Hulse et al. 2002), and the COP evaluation (measure 4.13).**
2. **Identify proposals for habitat restoration projects.**
3. **Forward those proposals that meet project selection criteria to NMFS for review and determination if they are consistent with improving survival and recovery.**
4. **Fund priority projects, through applicable programs and processes (see Table 9.7-2), that NMFS and FWS determine to be consistent with recovery plans for their respective ESA-listed species.**

Table 9.7-2 Authorities/Programs to Facilitate Implementation of Habitat Restoration Projects in the Willamette Basin

Program	Water Body	Description
Columbia River Basin Fish and Wildlife Program	Columbia Basin (including Willamette)	The Northwest Power Act of 1980 directs the Council to develop a program to protect, mitigate and enhance fish and wildlife of the Columbia River Basin that have been impacted by hydropower dams, and make annual funding recommendations to the Bonneville Power Administration for projects to implement the program. The Bonneville Power Administration then decides which projects to fund and implements the selected projects.
Continuing Authorities Program (CAP); (USACE Sections 206 & 1135 Programs)	Oregon	Continuing Authorities Program funds small restoration projects that address a variety of water resource and land related problems. A description of the CAP program is provided in section 3.5.2.3 of the Supplemental BA (USACE 2007a)
General Investigation Program (GI); USACE)	Oregon	Authority to conduct complex, large-scale, multiple purpose water resource projects. Applicable existing GI studies are described in Section 3.5.2.2 of the Supplemental BA and include: the Willamette River Floodplain Restoration Study; Eugene-Springfield Metro Area Watershed Feasibility Study, Lower Willamette Ecosystem Restoration Feasibility Study
Planning Assistance to States (PAS); USACE)		Authority to work with non-Federal sponsor to study and evaluate water and related land resource problems. Current study of North Santiam Gravel under this authority
Upper Willamette Watershed Ecosystem Restoration Authority (USACE Sec 3138 program)	Willamette watershed upstream of Albany	New authority from WRDA 2007 to conduct ecosystem restoration studies for the upper Willamette basin to protect, monitor, and restore fish and wildlife habitat.
Ecosystem Restoration and Fish Passage Improvement Authority (USACE Sec 4073)	Oregon	New authority in WRDA 2007 to conduct studies for ecosystem restoration and fish passage improvement on rivers throughout Oregon. Emphasis on fish passage and restoration to benefit species that are ESA listed. In conjunction with study, pilot project to demonstrate effectiveness of actions is authorized.
Sustainable Rivers Partnership with The Nature Conservancy	Willamette Basin	Cooperative agreement between USACE and The Nature Conservancy to assess and implement dam operational changes to better mimic natural river flows in the Willamette basin

7.1.3 By 2010, the Action Agencies will complete at least two of the highest priority projects that should result in significant habitat improvement for listed fish species. The Action Agencies will complete additional habitat projects each year from 2011 through the term of this Opinion. Alternatively, larger projects that might require several years to complete could be funded over a multi-year period instead of funding individual, smaller projects each year. NMFS will inform the Action Agencies whether they agree with the decision to fund and carry out these projects.

Rationale/Effect of RPA 7.1: This measure builds on the multiple studies and authorities the Action Agencies describe in the Proposed Action, section 3.5.2 through 3.5.4, of the Supplemental BA (USACE 2007a). It requires the Action Agencies to develop, fund, and carry out a comprehensive habitat restoration program for listed fish species in the Willamette basin.

Measure 7.1.1 acknowledges continued funding of existing projects in the Willamette watershed that provides some habitat improvements for UWR Chinook salmon and UWR steelhead. Although NMFS proposes to redirect project priorities to benefit these listed species, most of the funds for these projects have already been committed for other purposes, so only a small number of projects might be funded through this process. The Willamette Basin Mitigation project has some benefit, although limited, because it is directed primarily at terrestrial species. The Willamette Basin Mitigation projects will primarily benefit UWR Chinook salmon and UWR steelhead, and to a lesser degree, LCR Chinook salmon, LCR steelhead, and LCR coho salmon.

The priority for the new program and restoration projects described in RPA measures 7.1.2 and 7.1.3 is to maximize benefits for listed fish populations for which habitat degradation due to the Project is a major limiting factor. NMFS expects that most funded projects will have ecological benefits beyond helping listed fish species. Although specific projects are not identified, this measure provides enough certainty that the Action Agencies will establish a program, identify priority projects, acquire funding, and complete at least 2 projects by 2010, with additional projects funded and completed each year from 2011 through 2023, the term of this Opinion. This measure on its own would not be sufficient to offset continued population declines associated with degraded downstream habitat, but it does ensure an incremental improvement in downstream habitat, and would help to maintain populations at existing levels below the dams.

The effect of this measure is to offset adverse impacts of the Willamette Project on elements of critical habitat, such as degraded rearing and migration habitat in the mainstem Willamette and lower reaches of its tributaries caused by reduction in channel-forming flows and continued existence and maintenance of revetments. This measure will offset the effects by creating complex rearing habitat, adult holding habitat, and access to off-channel habitat, resulting in increased abundance and productivity of UWR Chinook salmon and UWR steelhead, and will improve the functioning of the PCEs for safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. If any projects are funded in the Willamette River below the falls, LCR Chinook salmon, LCR steelhead, and LCR coho salmon would also see small increases in abundance and productivity.

Some restoration projects will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008e). The positive effects of these projects on population viability and PCEs will be long term.

7.2 **Habitat Restoration and Enhancement on USACE Lands at Project Dams and Reservoirs: The USACE will continue to use existing authorities and programs for land and water resource stewardship on the lands it administers at the 13 Willamette projects to carry out aquatic and riparian habitat projects to benefit**

terrestrial organisms and resident fish species, in ways that do not harm ESA-listed species. Additionally, the USACE may design projects on USACE lands to benefit ESA-listed anadromous species. These actions will be carried out consistent with the best management practices identified in the "SLOPES IV Restoration" (NMFS 2008f) or other applicable biological opinions.

Rationale/Effect of RPA 7.2: In section 3.5.1 of the Proposed Action in the Supplemental BA (USACE 2007a), the Action Agencies propose to continue on-site habitat management activities aimed primarily at resident fish and wildlife species that use the reservoirs and adjacent lands. NMFS includes this measure to ensure that continued on-site activities are reviewed and modified, if necessary, to avoid adverse effects on listed UWR Chinook salmon and UWR steelhead. Further, on-site habitat projects that benefit UWR Chinook salmon and UWR steelhead should be funded through this program.

NMFS cannot quantify the effect of this measure on listed fish or critical habitat because the measure does not specify the number of projects or magnitude of benefit that should be directed at listed anadromous species. Insufficient information is available to assess the value of these reservoirs for rearing juvenile salmon and steelhead, and thus NMFS cannot determine how much, if any, habitat restoration work is needed in the reservoirs and adjacent aquatic habitat. However, this measure will provide benefit to listed anadromous fish because it will ensure that there are adequate protections for listed salmonids when the Action Agencies are conducting projects that benefit other species.

7.3 **Large Wood Collected at Project Dams: During annual maintenance operations, the Action Agencies will collect large wood that accumulates at Project dams and make it available for habitat restoration projects above and below Project dams.**

Rationale/Effect of RPA 7.3: This new measure that is not addressed in the Proposed Action is aimed at restoring large wood transport past Project dams. The continuing effects of Project dams on interruption of large wood transport were discussed in detail in each of the major tributary Effects sections (Middle Fork Willamette Section 5.2.4, McKenzie Section 5.3.4, South Santiam Section 5.5.4, and North Santiam Section 5.6.4). Lack of large wood in downstream fish habitat continues to reduce available rearing and holding habitat for juvenile and adult UWR Chinook salmon and steelhead. This measure ensures that large wood that collects in the reservoirs will be made available for such projects.

The effect of this measure is generally positive for listed anadromous fish because it is a first step in the process of habitat restoration that provides large woody debris that is a benefit to the fish and habitat elements.

7.4 **Restoration of Habitat at Revetments: In coordination with the Services, the Action Agencies will undertake a comprehensive assessment of revetments placed or funded by the USACE Willamette River Bank Protection Program. The revetment assessment will be completed, including identifying sites with potential for**

modification, by December 31, 2010. The USACE will use applicable existing authorities and programs for funding habitat restoration identified in Table 9.7-2, as well as new programs that are applicable, to fund priority projects identified in this assessment.

Rationale/Effect of RPA 7.4: This measure provides additional certainty to the Willamette River Bank Protection Program study described in section 3.5.4 of the Proposed Action (USACE 2007a). The Action Agencies indicated in that section that they had not identified funding sources or a timeline for conducting the study or follow-up actions. This RPA measure requires the USACE to secure funds for the study and complete it by December 31, 2010. Once completed, the Action Agencies would be required to seek funds to carry out projects at high priority sites.

The effect of this measure is that high priority sites for restoration or removal will be identified in the near term, and will be considered for funding through applicable authorities and programs. When projects are funded and carried out, the effect will be improved rearing and holding habitat, by opening access to off-channel rearing habitat and allowing establishment of complex habitat used for rearing and holding.

7.5 **Aquatic Habitat Assessment: By June 2008, the Action Agencies will complete surveys of spawning and holding habitat availability and condition in the major spawning tributaries with USACE dams (N. Santiam, S. Santiam, South Fork McKenzie, and Middle Fork Willamette rivers). The Action Agencies will distribute copies of the final report to the Services and will make the report available on the USACE's Portland District's website. Habitat survey data will also be available to the public in a GIS format. The Action Agencies will use the assessment to inform habitat restoration priorities for RPA measure 7.1.**

Rationale/Effect for RPA 7.5: The Action Agencies propose to complete this assessment by the end of FY 2008 (i.e., end of September 2008). These surveys will provide essential information for decision-makers regarding the availability of suitable habitat above and below Project dams for UWR Chinook salmon and steelhead.

9.8 ESA Compliance & Coordination

These measures are based on similar Proposed Action measures in section 3.6.5 of the Supplemental BA (USACE 2007a). Additionally, the coordination process described in these measures is encompassed within RPA measure 1, Coordination, of this Chapter 9. However, the following measures add specificity to those measures with regard to design review and construction implementation. Specificity is necessary to ensure that needed reviews will happen and that construction will be accomplished in a way that minimizes impacts on listed fish.

RPA 8 ESA Compliance, Maintenance, and Construction Projects Environmental Coordination and Management

8.1 **Review of Design and Construction Reports: The Action Agencies will collaborate with the Services on the design, construction and operation of all potential structural modifications to the dams and associated facilities, including fish collection and handling facilities, fish passage improvements, and water temperature control facilities. The Action Agencies will obtain the Services' review[45] of design reports and will address their recommendations in subsequent design reports. The Action Agencies will provide final design reports and drawings to the Services at least 30 days in advance of making the final design decision to allow time for their review and comment.**

Rationale/Effect of RPA 8.1: This measure is needed to ensure constructive collaboration between the Services and the Action Agencies to ensure facilities will be designed and constructed to be as benign to fish as possible. This review will take place as part of one of the technical subcommittee of the WATER group, as described in measure 1.2, and that decisions will be made according to the processes described in measures 1.3 and 1.4.

The effect of this measure is that facilities will be designed and constructed to minimize injury, mortality, and delay of listed fish, resulting in improved abundance and productivity, and in certain cases such as for fish passage facilities, increased spatial distribution of UWR Chinook salmon and steelhead.

8.2 **Construction Practices: Construction and operation will be carried out according to Best Management Practices (BMPs) and design specifications agreed[46] to by the Services. The Action Agencies will follow BMPs provided in Section 12, Incidental Take Statement. If these are updated, the Services will provide the updates to the Action Agencies, and the Action Agencies should follow the updated BMPs.**

Rationale/Effect of RPA 8.2: This measure builds on the Action Agencies' Proposed Action in section 3.6.5 of the Supplemental BA (USACE 2007a), in which the Action Agencies agreed to adopt and follow BMPs for construction of all potential structural modifications to the dams and associated facilities. In their Proposed Action, the Action Agencies agreed to use the BMPs outlined in NMFS' Biological Opinion concerning construction of the Cougar adult fish collection facilities (NMFS 2007a) as a starting point, and proposed to use a technical subcommittee of the WATER group to further refine BMPs. NMFS provides this modified measure to require BMPs consistent with those identified in the Incidental Take Statement for this Opinion, included as chapter 11. Additionally, NMFS broadens the action to apply to all construction activities that may include in-water work or affect fish or fish habitat, rather than only for fish facility construction.

The effect of this measure is that construction projects carried out as part of the Proposed Action, including continued Project operation and maintenance, revetment maintenance,

[45] See RPA 1.3 and 1.4 for elaboration of the decision making process.
[46] See RPA 1.3 and 1.4 for elaboration of the decision making process.

and fish and wildlife mitigation measures, will be done in a manner that minimizes harm to listed fish and avoid negative effects to critical habitat.

9.9 RESEARCH, MONITORING & EVALUATION (RM&E)

In their Proposed Action, the Action Agencies identify the need for developing a comprehensive research, monitoring, and evaluation (RM&E) program that will provide information necessary for making informed adaptive management decisions, in addition to tracking and documenting progress toward achievement of these RPA measures. They further identify the practicality of developing and managing this RM&E program under the auspices of the cooperative WATER subcommittee structure.

The Action Agencies provide certain guiding principles and strategic questions for consideration in developing a sound RM&E program. They also provide areas of concern where RM&E studies are needed. However, they generally do not make specific study recommendations.

The following RPA measures combine with portions of the PA and RPA measures described above to identify the broad outlines of an adaptive RM&E program. A comprehensive RM&E program is essential to guiding Action Agencies' decisions in carrying out PA and RPA measures and that will affect productivity, abundance, spatial distribution, and genetic diversity of listed fish species. Additional and specific details of the RM&E program, study objectives, and methodologies will be developed and refined through the WATER process.

RPA 9 Research, Monitoring & Evaluation (RM&E)

9.1 **<u>Comprehensive Program:</u> The Action Agencies will, in consultation with the WATER RM&E subcommittee, established as a technical subcommittee as described in RPA measure 1.2, develop and manage the comprehensive Willamette Project RM&E program. In developing and conducting the RM&E studies, the Action Agencies will work closely with the Services to ensure that the studies will provide information useful to the Services and the Action Agencies in making decisions regarding the effectiveness of mitigation measures in the Proposed Action and the RPA, including alternatives for downstream flows and ramping, fish passage, water quality, hatchery program operations, habitat restoration and other measures. The Action Agencies will seek NMFS' review of draft study proposals and draft reports. Comments submitted by NMFS on draft evaluation proposals must be reconciled by the Action Agencies in writing to NMFS' satisfaction prior to initiating any research-related activities anticipated in this RPA.[47] The proposals must identify annual anticipated incidental take levels by species, life stage, and origin[48] for each year. The Services will inform the Action Agencies whether they agree[49] with the proposed studies, reports, and NEPA alternatives. The Action**

[47] See RPA 1.3 & 1.4 for elaboration of decision making process.
[48] That is, hatchery-origin or non-hatchery origin fish.
[49] See RPA 1.3 & 1.4 for elaboration of decision making process.

Agencies will make modifications to operations and facilities based on the results of the RM&E information.

Rationale/Effect of RPA 9.1: Research, monitoring, and evaluation studies comprise an essential and important component of the protective measures identified within the RPA. Often lacking within the basin is detailed information regarding geographically-specific environmental conditions (e.g., quantity and distribution of functional spawning and rearing habitat) and the extent to which ongoing Willamette Project operations are continuing to affect those conditions (e.g., flow variation and duration in relation to sediment transport dynamics, channel and habitat complexity, and related juvenile fish behavior and survival). In other instances, problems attributable to Willamette Project dams and operations (e.g., migration barriers and water temperature alteration) require additional information to assess the most prudent and effective means of overcoming these important limiting factors. Consequently, the functional effectiveness of RPA measures often depends upon the ability to make informed and timely decisions regarding the most effective and practical means of achieving protection and restoration objectives associated with each of the listed species. In studies aimed at obtaining this information, and in documenting tangible progress toward achieving protection and restoration objectives, the Services must discern whether the proposed studies are designed and conducted in a manner that is in keeping with the original intent of the RPA measures. They must also assure that the results of these studies are effectively applied.

Other kinds of RM&E include monitoring the existing and new mitigation measures. This is necessary to ensure that the measures are functioning properly and continue to do so. Also, the RM&E information can be the basis for making modifications to make them function effectively.

The effect of this measure is that the Action Agencies will have a basis for informed decisions about new mitigation measures, and will be able to ensure that current and new measures will be effective, and can modify them as needed.

9.2 **<u>Mainstem Flow, Tributary Flow, and Ramping RM&E:</u> The Action Agencies will develop and carry out RM&E to determine compliance with, and effectiveness of, flow and ramping measures and to better discern and evaluate the relationships between flow management operations and the resulting dynamics of ecosystem function and environmental conditions downstream of Willamette Project dams. Because flow releases and ramping rates are measures that can be implemented immediately, the Action Agencies should give high priority to studies to evaluate their effectiveness. The Action Agencies will begin flow and ramping rate studies by 2009. The Action Agencies will make modifications to Project operations and facilities that affect mainstem and tributary flows, ramping, and Reclamation water contract implementation, including RPA measures 2 and 3 listed above, no later than January 2011, as indicated by results of the monitoring and evaluation, and with NMFS' agreement.**

Rationale/Effect of RPA 9.2: The studies and monitoring of mainstem and tributary flow rates and of project ramping rate restrictions, as identified above in RPA2.10 (Flow-Related RM&E) of Section 9.2 (Flow Management), are necessary to acquire specific information about the functional relationship between rates of flow (e.g., flow stage), or change in flow, and resulting habitat conditions, fish behavior, and survival (e.g., winter steelhead spawning in the North and South Santiam rivers during spring; juvenile fish stranding during flow level changes). Information from physical habitat surveys and from hydrologic modeling will provide the data needed to make informed decisions regarding the adequacy and effectiveness of the mainstem and tributary flow measures.

The effect of this measure is that it will provide the basis for decisions on important mitigation measures, mainstem flow, tributary flows, and ramping rates that are adequate for listed fish protection. The measure includes interim measures for these flows and ramping, so it will help listed fish in the short term by improving their habitat downstream of the dams.

9.3 **Fish Passage RM&E: The Action Agencies will develop and carry out RM&E to determine the most effective and efficient means to accomplish safe fish passage at applicable Project dams. The studies will be used to determine 1) locations where it is feasible to re-establish self sustaining populations; 2) potential population size for each subbasin; 3) effectiveness of rebuilt trap-and-haul facilities; 4) downstream fish passage timing and survival through Project reservoirs; 5) downstream fish passage timing and survival through Project dams; 6) operational methods for higher juvenile and adult survival at Project facilities; 7) infrastructure needs to ensure long term viability of populations; and 8) selection of hatchery or natural-origin broodstock, as well as life stage, for release into habitat above Project dams.**

These facilities must meet performance standards consistent with NMFS' Fish Passage Criteria and Guidelines (NMFS 2008e) or as determined through the FPHM committee of WATER and agreed to by the Services. The Action Agencies will monitor the effectiveness of the fish passage facilities. The Action Agencies will make modifications to Project operations and facilities that affect fish passage, including RPA 4 measures listed above, as indicated by results of the monitoring and evaluation, and with NMFS' agreement.

Rationale/Effect of RPA 9.3: Most historical production areas for UWR Chinook salmon and for UWR steelhead lie above federal dams in the Willamette River Basin. In general, the quality of the remaining habitat in these areas (e.g., on U.S. Forest Service lands) is also superior to that of the available habitat remaining below the dams. Re-accessing this habitat is a fundamentally important component of the strategy for protecting and restoring these listed species. Downstream fish passage through reservoirs and dams is influenced by unique characteristics at each site, such as dam configuration, reservoir length and depth, and life stage and physiological state of fish as they move downstream. In other words, what works at one project may not work at another, and thus, a study regarding the most effective and feasible means of re-accessing this habitat is essential.

This measure is needed to ensure that once passage facilities or operations are implemented at a Project dam, monitoring will take place to determine if facilities are performing as intended. If the facilities are not providing safe and effective passage, then they need to be modified accordingly. Performance standards are necessary to provide a quantitative measure of effectiveness.

The effect of this measure is to provide information to make decisions on passage measures that are one of the most important kinds of mitigation for project effects. It will also ensure that passage is working effectively.

9.4 **Water Quality RM&E: The Action Agencies will develop and carry out RM&E to monitor the effectiveness of measures in the RPA and Proposed Action to improve water quality, including but not limited to: 1) monitor operational performance and associated biological response of water temperature control in the McKenzie River Subbasin at Cougar Dam; 1a) quantify effects of USACE dams on water temperature; 2) evaluate biological effects of water temperature alteration caused by USACE dams on ESA listed fish species in the Santiam and Middle Fork Willamette rivers; 2a) quantify the effects of USACE dissolved gas and turbidity; 3) evaluate the effects of dissolved gas supersaturation and of turbidity alterations caused by USACE dams on ESA listed fish species in the Santiam, McKenzie, and Middle Fork Willamette rivers; and 4) conduct an aquatic macroinvertebrate species abundance and community structure study at USACE projects on the Santiam, McKenzie, and Middle Fork Willamette rivers to discern the extent to which project operations affect macroinvertebrate community composition, structure, and function. The Action Agencies will make modifications to Project operations and facilities that affect water quality, including RPA measure 5 (and its sub-measures) listed above as indicated by results of the monitoring and evaluation, and with NMFS' agreement.**

Rationale/Effect of RPA 9.4: It is well documented that Willamette Basin projects have dramatically affected water temperatures below federal dams, and also affect other important water quality parameters, to the detriment of listed species. These studies are necessary to document geographically-specific effects, their relevance to protection and the water quality RPA measures 5, and the tangible options for addressing these concerns.

9.5 **Hatchery Programs RM&E: The Action Agencies will develop and carry out RM&E to monitor the effectiveness of hatchery measures in the RPA and Proposed Action to improve hatchery effectiveness and reduce adverse effects to listed fish species, including but not limited to the following:**

9.5.1 **Spring Chinook**

1. **Broodstock Management- Determine collection and spawning timing of broodstock, composition of hatchery and wild fish.**

2. **Composition of Hatchery Fish on the Spawning Grounds- Determine the abundance, distribution, and percent hatchery-origin Chinook on the spawning grounds of each population annually.**
3. **Survival of Adult Hatchery Fish Outplanted above Federal Dams- Determine the survival rate of outplanted fish and abundance of spawners above the dams.**
4. **Reproductive Success of Hatchery Fish in the Wild- Determine juvenile production by hatchery and wild spawners above the dams.**
5. **Use of Hatchery Fish to Evaluate Migration and Survival through Reservoirs and Dams- As hatchery program reforms are implemented to make hatchery fish more similar to wild fish, use hatchery fish as a surrogate for wild fish in the testing and evaluation of migration, behavior, and survival of fish through the reservoirs and dams. Wild fish may be used in the future if risks are deemed acceptable.**

9.5.2 **Summer Steelhead**

1. **Fund, design, and implement a study plan, in collaboration with ODFW, to determine the extent of summer steelhead reproduction in the wild. Collect tissue samples from juvenile steelhead for genetic analysis to determine if offspring are of winter- or summer-run origin. Sampling shall begin in 2009. Details to be worked out by the Research, Monitoring, and Evaluation Committee.**
2. **Fund and conduct a spawning survey for three years (i.e. 2010-2012) to determine the extent of summer steelhead spawning in the North Santiam River Basin. Survey shall be initiated after the reduction of the North Santiam hatchery summer steelhead release is implemented.**

Rationale/Effect of RPA 9.5: The RM&E tasks identified above for the hatchery programs are essential in order to evaluate the effects of hatchery fish spawning in the wild and to determine how many natural-origin fish are being taken for broodstock. Information on both of these attributes helps inform and guide future management decisions on these hatchery programs and helps determine the status of listed populations. In addition, the Chinook hatchery programs are being used in many cases to reintroduce Chinook back into historical habitats above Project dams, thus it is necessary to evaluate the success of these outplanting programs.

9.6 **Habitat Restoration RM&E: The Action Agencies will develop and carry out RM&E for habitat restoration projects identified in the Proposed Action and this RPA to document changes in ecosystem function and biological response. The Action Agencies will make modifications to Project-related habitat restoration activities and structures, including RPA 7 measures listed above, as indicated by the results of the monitoring and evaluation and with NMFS' agreement.**

Rationale/Effect of RPA 9.6: The functional relationship between the characteristics and dynamics of habitat and related biological responses is poorly understood, in general. This is due, in part, to the complexity of those relationships and, in part, to the failure of restoration efforts to document their resulting biological effects. Careful planning of

projects, with stated assumptions and objectives, in combination with post-construction physical and biological monitoring is required to document that intended benefits are realized. The information gained from this endeavor will provide the documentation required to make informed and adaptive management and planning decisions.

9.10 MAINTENANCE

These maintenance RPA measures are based on similar measures[50] described in the Proposed Action and apply to any constructed or fabricated features whose failure or improper function might affect ESA-listed fish and fish habitat such as, but not limited to, dams, gates, valves, pumps, access roads, fish hauling trucks, electrical power transmission grids, signal, control devices, and fish facilities.

These measures do not apply to the following:

- riverine components of the Willamette Project such as revetments, riprap, or riparian habitat improvements,
- re-configuration or rebuilding[51] of existing facilities (until they are placed in service.),
- items that are not likely to affect fish, such as building renovations, campground maintenance, recreational facilities, and
- preventative or routine maintenance.

The following measures add specificity to those maintenance measures in the Proposed Action:

RPA 10 Maintenance

10.1 **<u>Identify fish protection maintenance needs</u>. The USACE will develop and maintain a list of scheduled and unscheduled maintenance needs of existing infrastructure that could potentially negatively impact listed fish and will place high priority on maintaining performance of all such facilities. The scope of maintenance activities included encompasses all USACE dams, facilities, and appurtenances that *may significantly and adversely affect listed fish*, and includes not only "fisheries" facilities such as fish traps but all facilities required to meet the operations described in this Opinion (e.g. because forced spill can adversely affect downstream water quality, items such as turbines and generators may fall within this purview). This measure also affects those hatcheries raising listed fish, and all related hatchery facilities, including fish hauling trucks and related equipment used in fish transfers.**

The timeline for database modification and data entry:

[50] USACE 2007a including, but not limited to, pages 3-5, 6, 17, 18, 40, 41, 53, 54, 55, 56, 59, 68, 69, 71, 79-81, 91,136,137.

[51] Defined as measures costing more than 25% of the replacement cost of the existing structure.

1) All new items entered after 2008 shall include information noting whether they *may significantly and adversely affect listed fish,*[52]

2) All items, both new and pre-existing, shall be so notated by and after 2015[53].

Rationale/Effect of RPA 10.1: This RPA measure clarifies and makes uniform the maintenance reporting requirements for fish protection at all Project elements. USACE has a comprehensive maintenance program, including an associated database of maintenance needs. This RPA measure will enhance the USACE's database by associating with each discrepancy or defect noted in the maintenance database whether the needed maintenance *may significantly and adversely affect listed fish.* This measure is needed to ensure that all facilities that might affect listed fish—not merely fish facilities—will be maintained to minimize adverse effects to listed fish and fish habitat caused by equipment malfunctions.

The effect of this measure is to clarify that all facilities will be maintained to minimize injury, mortality, and delay of listed fish and destruction of fish habitat, resulting in improved abundance and productivity, and in certain cases such as for fish passage facilities, increased spatial distribution of UWR Chinook salmon and steelhead.

10.2 **Inventory of Needed Maintenance: The USACE will provide the maintenance report described in the Proposed Action (USACE 2007a, p. 3-18 Item 2 in Section 3.2.2[54]) in electronic[55] database format to NMFS by February 1, 2009, and thereafter whenever requested in writing by NMFS. This report will include an inventory of current major deficiencies, (i.e., where facilities are in need of maintenance or replacement) and the anticipated date of correction, and for those previously identified maintenance items that have been corrected, the report will identify the date the deficiencies were corrected. To aid in the identification of repeated problems, all corrected deficiencies will be retained in the database.**

Rationale/Effect of RPA10.2: This measure builds on the Action Agencies' commitment to maintain project facilities included in the Proposed Action. The Action Agencies commit "to describe scheduled and unscheduled" maintenance, but do not commit to reporting or inventorying discovered discrepancies, or their correction. The effect of this measure will be to ensure that the Action Agencies will maintain an orderly and systematic record of maintenance deficiencies and problems that might affect listed fish and a record of when these deficiencies are corrected. Ultimately, in conjunction with the measure below, this will assist in minimizing harm to listed fish and avoiding degradation of designated critical habitat.

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[52] That is, this is not an immediate requirement to go through the existing database—at least for five years-- to determine whether the items in the existing backlog *may significantly and adversely affect listed fish.*

[53] The intent here is to avoid an immediate requirement to research each of reportedly 30,000 items in the existing maintenance database for their impact on fish. During this five-year period any new deficiencies entered into the database will be annotated with respect to their possibility to affect fish. Presumably, many of the currently existing deficiencies will have been corrected within 5 years, so at the end of this period the task of assessing remaining deficiencies will not be great.

[54] Now within the Willamette Fish Operations and Management Plan--WFOP

[55] MS Access format or other mutually agreed upon format.

10.3 **Perform Timely Maintenance: The Action Agencies will correct the items noted in the inventories identified in RPA measures 10.1 and 10.2 above in a timely manner. All identified maintenance needs will be corrected, subject to congressional appropriation, or unless otherwise concurred with by NMFS. Notwithstanding, the USACE will correct deficiencies likely to cause substantial fish injury, mortality, or habitat degradation as soon as reasonably possible after discovery. The determination of whether injury, mortality, or loss of habitat function will occur in any particular instance will be collaboratively determined by NMFS and the Action Agencies.**

***Rationale/Effect of RPA 10.3*:** The Action Agencies have committed "to describe scheduled and unscheduled" maintenance (USACE 2007a), but have not actually committed to a timeline for correcting maintenance discrepancies.

The effect of this measure will be to minimize the likelihood of mortality and injury of adult and juvenile UWR Chinook and steelhead associated with malfunctioning equipment, unscheduled shutdowns, toxic substances, and other consequences of maintenance discrepancies. Additionally, this measure will reduce the likelihood of degradation of designated critical habitat for UWR Chinook and steelhead caused by malfunctioning equipment and other consequences of maintenance discrepancies.

9.11 Conclusion: Effects of the Reasonable & Prudent Alternative

This section presents NMFS' rationale for concluding that with the adoption of this RPA, the Action Agencies would avoid jeopardizing listed species and adversely modifying their critical habitats while operating and maintaining Project facilities and revetments, funding the hatchery mitigation program, and administering the water service program. This rationale is presented for the species that NMFS concluded would be jeopardized by the proposed action (UWR Chinook salmon and UWR steelhead) and for the other species that would be affected by the RPA.

The Proposed Action would jeopardize the continued existence of UWR Chinook salmon and UWR steelhead, and would destroy or adversely modify critical habitat because it did not adequately address adverse effects of the dams, revetments and hatcheries on listed fish, factors that are suppressing the viability of both species and are contributing to the high risk of extinction for UWR Chinook.[56] NMFS' RPA provides a package of measures that will allow for the survival with an adequate potential for recovery for these two species. The main negative effects of the Proposed Action are lack of effective passage to important habitat, degradation of remaining habitat, adverse flows and temperature, and hatchery actions that have the potential to reduce the viability of the natural-origin populations. The RPA provides specific measures that will address project effects by improving the status of natural-origin UWR Chinook salmon and UWR steelhead. The RPA measures will improve spatial distribution (habitat access; geographic range), diversity (hatchery broodstock management), productivity (improved conditions below the dams), and abundance (reduced mortality rates), which are the four VSP parameters.

[56] The WLCTRT (McElhany et al. 2007) estimated the risk of extinction over 100 years for UWR Chinook ("high;" see Figure 3-5 in Section 3.2.1.3). The TRT did not estimate the species' short-term extinction risk.

Improvements in these four VSP parameters will increase viability and reduce the risk of extinction to the affected populations and to the UWR Chinook salmon ESU and UWR steelhead DPS as at the species level. The RPA provides increased certainty that Proposed Action measures intended to benefit listed species will be accomplished within reasonable time periods to prevent extinction in the short term and to support improvements in UWR Chinook salmon and UWR steelhead abundance. RPA measures also improve habitat PCEs, ensuring that critical habitat will be able to serve its conservation role.

9.11.1 UWR Chinook Salmon

9.11.1.1 Effects of the RPA

The RPA specifies many significant measures that will reduce the adverse effects of the Willamette Project on the UWR Chinook ESU and bring about the proper functioning of primary constituent elements (PCEs) of its critical habitat. Many of the RPA measures specifically address key limiting factors/threats facing each population and caused by the Willamette Project: lack of passage, the degraded quality of the remaining habitat downstream of the dams; and the risks of genetic introgression, competition, and predation from hatchery fish. Four core populations have been identified for this ESU (Middle Fork Willamette, McKenzie, South Santiam, and North Santiam; see Chapter 3), and each of these populations will benefit from major RPA measures in the form of access to historical habitat, and/or temperature control and flow measures within the first few years of implementation (Section 9.11.1.3.1). With full implementation of the RPA, NMFS expects that the status of the ESU, including the four VSP parameters, will improve significantly compared to their potential status under the Proposed Action.

As shown in Table 9.11-1, several major RPA measures will be completed between 2015 through 2024, including passage at dams in the Middle Fork and South Santiam, which will provide safe passage to and from historical upstream habitat, and temperature control to improve downstream habitat in the North Santiam. Most of these measures are major construction projects that take a significant amount of time to plan, fund, and execute. For a full description of the authorization and funding processes needed for these types of measures, see the Supplemental Biological Assessment (USACE 2007a). It is not economically and technically feasible to move the timelines for many of these measures forward significantly due to their magnitude and the time needed for studies, design, authorization and construction.

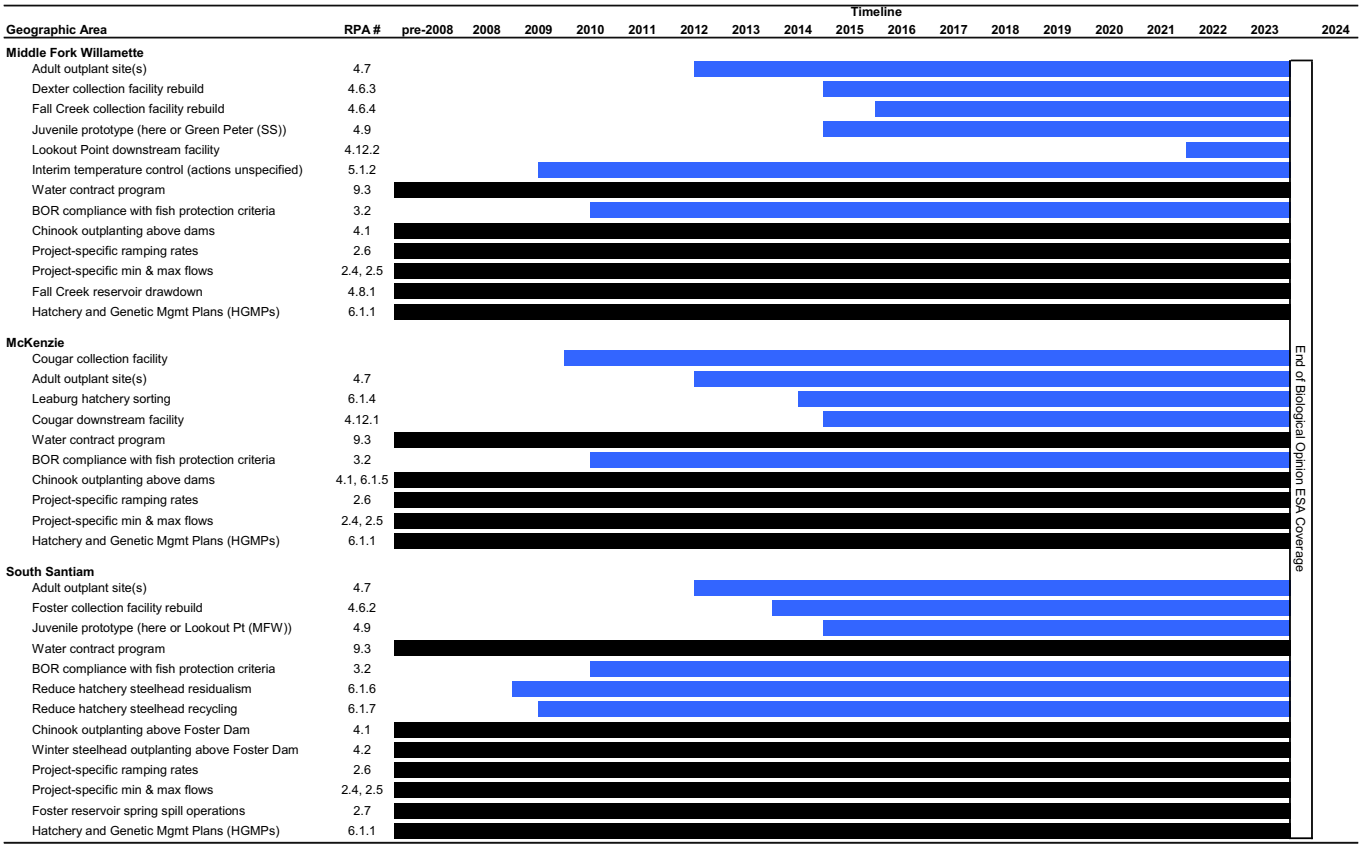
Given these constraints, the anticipated population status improvements will begin in the next 15 years and continue to increase over the 15-year term of this Opinion. It will take several generations of the Chinook life cycle to respond to the positive improvements in the operation of the Willamette Project and associated measures. Therefore, significant improvements in the status of the ESU will continue to accrue in the next 30 years (approximately six generations). While implementation of these RPA measures will occur during the term of this Opinion, their full effects on population metrics (e.g., abundance, productivity) will occur over a considerable period of time after implementation. Therefore, NMFS expects that substantial improvements to the ESU will result from the implementation of the Proposed Action and the RPA.

In addition to the major measures specified in Table 9.11-1, numerous other near-term measures such as changes to flow, screening irrigation diversions, hatchery program modifications, and habitat mitigation projects are included in the RPA. The "near-term" measures in Table 9.11-1 directly address project effects on listed fish and critical habitat without requiring as many years to plan and implement as the measures discussed above. A third group of measures, such as conducting RM&E studies, developing fish operations manuals, project planning, and implementing the WATER collaborative process, will begin in the near term. Although this third group of activities also has not been included in the summary table, these are essential tasks that will facilitate construction of the large structures as well as guide annual operations, all of which will benefit UWR Chinook.

Difference between the Proposed Action and RPA

The effect of the RPA measures on UWR Chinook is significantly different than the effect of the Proposed Action. The Proposed Action mainly provided for further studies to consider options such as passage facilities to historical upstream habitat, as well as a major downstream habitat improvement measure of temperature control. In addition, the RPA includes measures to improve degraded downstream habitat through changes to flows, screens at irrigation diversions, hatchery improvements, and other habitat improvement projects. These RPA measures are significant because UWR Chinook are currently limited to degraded downstream habitat in three important subbasins. The RPA measures both provide access to higher quality habitat and improve downstream habitat conditions, which together will provide significant enough improvements to allow the UWR Chinook ESU to increase in numbers, productivity, spatial structure, and diversity.

Table 9.11-1 Date of implementation of the RPA measures that will directly benefit UWR Chinook salmon and steelhead and their habitat.



Geographic Area	RPA #
Middle Fork Willamette	
Adult outplant site(s)	4.7
Dexter collection facility rebuild	4.6.3
Fall Creek collection facility rebuild	4.6.4
Juvenile prototype (here or Green Peter (SS))	4.9
Lookout Point downstream facility	4.12.2
Interim temperature control (actions unspecified)	5.1.2
Water contract program	9.3
BOR compliance with fish protection criteria	3.2
Chinook outplanting above dams	4.1
Project-specific ramping rates	2.6
Project-specific min & max flows	2.4, 2.5
Fall Creek reservoir drawdown	4.8.1
Hatchery and Genetic Mgmt Plans (HGMPs)	6.1.1
McKenzie	
Cougar collection facility	
Adult outplant site(s)	4.7
Leaburg hatchery sorting	6.1.4
Cougar downstream facility	4.12.1
Water contract program	9.3
BOR compliance with fish protection criteria	3.2
Chinook outplanting above dams	4.1, 6.1.5
Project-specific ramping rates	2.6
Project-specific min & max flows	2.4, 2.5
Hatchery and Genetic Mgmt Plans (HGMPs)	6.1.1
South Santiam	
Adult outplant site(s)	4.7
Foster collection facility rebuild	4.6.2
Juvenile prototype (here or Lookout Pt (MFW))	4.9
Water contract program	9.3
BOR compliance with fish protection criteria	3.2
Reduce hatchery steelhead residualism	6.1.6
Reduce hatchery steelhead recycling	6.1.7
Chinook outplanting above Foster Dam	4.1
Winter steelhead outplanting above Foster Dam	4.2
Project-specific ramping rates	2.6
Project-specific min & max flows	2.4, 2.5
Foster reservoir spring spill operations	2.7
Hatchery and Genetic Mgmt Plans (HGMPs)	6.1.1

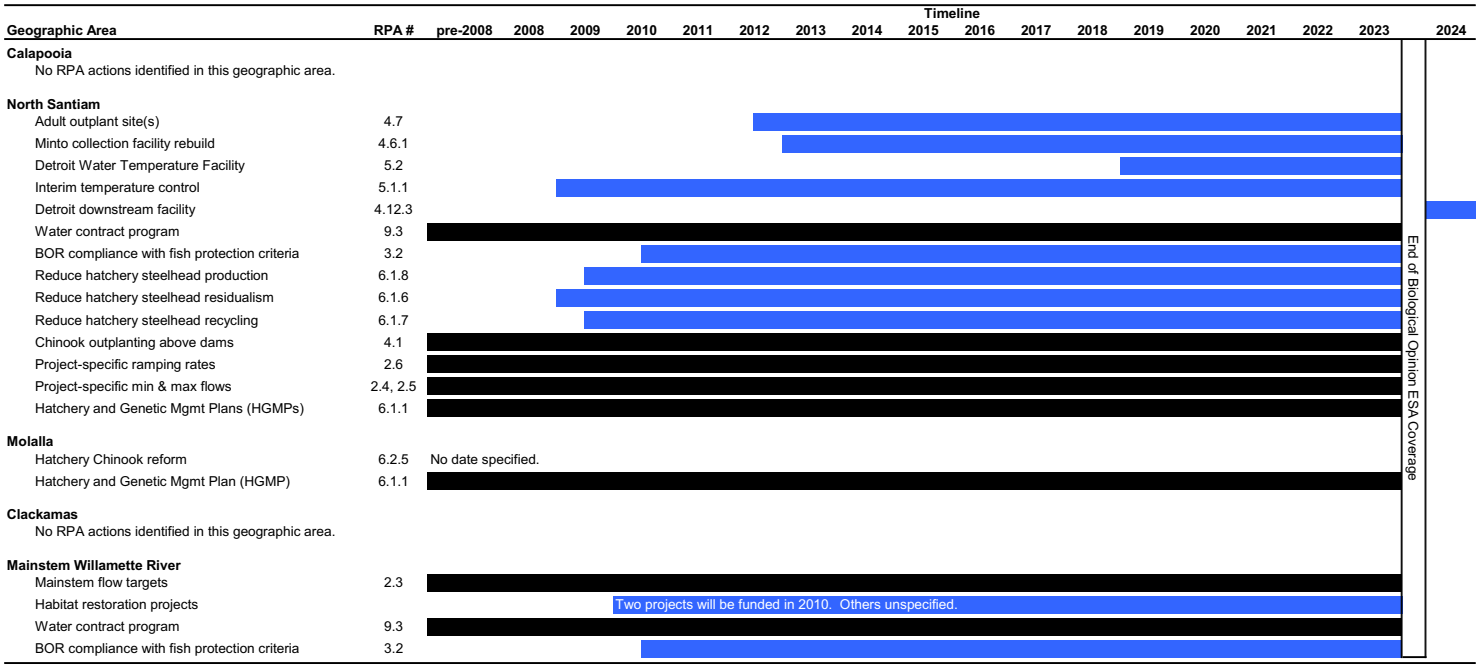
ongoing, continuing measures that have been in effect prior to the completion of this Biological Opinion

new measures that will be taken in the future (after this Biological Opinion is completed)

* This chart summarizes only a portion of the measures analyzed in this Opinion. Numerous other planning processes other planning processes, operational protocols and guidelines, research monitoring and evaluation, emergency operation plans are not included here.

Table continued on next page.

Table 9.11-1. ***(Continued)***



* This chart summarizes only a portion of the measures analyzed in this Opinion. Numerous other planning processes other planning processes, operational protocols and guidelines, research monitoring and evaluation, emergency operation plans are not included here.

9.11.1.2 UWR Chinook Populations—Summary of Effects of the RPA

The following is a population-by-population summary of the effects of the RPA. The RPA and the analysis in this section specifically address short-falls in the effects of the Proposed Action, which are identified in earlier sections of this Opinion (see especially Chapter 7, "Summary of Effects of the Proposed Action on UWR Chinook and Steelhead.")

Middle Fork Willamette Chinook

The primary reason for the poor status of the Middle Fork Willamette Chinook population (very high risk of extinction) is the loss of access to historical habitat due to the four Willamette Project dams and elevated temperatures in the reach below Dexter Dam and in lower Fall Creek. The risk of genetic introgression from hatchery-origin fish interbreeding with those of natural origin is also a key limiting factor.

- The RPA will improve upstream passage survival by rebuilding the collection facilities at Dexter and Fall Creek dams to reduce stress, injury, and mortality during capture and handling of Chinook salmon for outplanting (safe passage) above Project dams.

– *RPA 4.6: complete construction at Dexter by December 2014 and begin operations by March 2015; complete construction at Fall Creek by December 2015 and begin operations by March 2016*

- Construction and operation of new adult release sites above Lookout Point, Hills Creek, and Fall Creek dams will increase upstream passage survival and reduce pre-spawn mortality by minimizing stress and injury of adult Chinook salmon outplanted above the dams.

– *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*

- A downstream passage facility at Lookout Point reservoir/dam will allow higher survival of juvenile Chinook emigrants resulting from the adult outplanting program.

– *RPA 4.9: build prototype for head-of-reservoir juvenile collection facility at Lookout Point or Foster by 2014*

– *RPA 4.12.2: develop permanent downstream passage facility at Lookout Point—begin feasibility studies by 2012, construct by December 2021, and operate by March 2022 (if not feasible, make "no go" decision by end of 2014)*

- Drawdown to at least elevation 714.0 by the end of November each year will optimize downstream passage conditions at Fall Creek Dam during the juvenile outmigration.

– *RPA 4.8.1: reduce head by implementing Fall Creek drawdown beginning in Water Year 2008 (Nov-Jan, except during flood control operations), reducing injury and mortality of Chinook smolts*

- Interim operational measures at Lookout Point, Hills Creek, and Fall Creek dams will restore normative seasonal water temperatures.

– *RPA 5.1.2: Identify interim measures by March 2010*

- *RPA 5.1.3: Evaluate more complex measures (requiring detailed environmental review, permits, and/or congressional authorization) by April 2011*

- Address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flow patterns below dams, and the maintenance of revetments) on downstream habitat

- *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*

- *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*

- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Screening diversions will remove impediments or barriers to juvenile Chinook migrants

- *RPAs 3.2 and 3.3: Reclamation will require that existing, new, and renewed contracts for stored water include conditions that protect fish from entrainment into diversions.*

- Adverse effects of the Chinook hatchery program will be minimized.

- *RPAs 6.1.2 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*

- *RPA 4.6: improve fish collection facility at Dexter Ponds (begin construction by December 2014 and begin operations by March 2015) and at Fall Creek Dam (begin construction by December 2015 and begin operations by March 2016).*

- *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark, and insert coded wire tags into all hatchery Chinook prior to release*

- *RPA 6.2.4: cooperate with ODFW to release juvenile hatchery-origin Chinook that are more similar to natural-origin fish.*

The combined effect of these measures (especially the mechanisms for efficient sorting of hatchery fish for broodstock and to augment spawning above Dexter and Fall Creek dams, improvements in downstream passage survival in the Middle Fork Willamette and Fall Creek and in water temperatures in the Middle Fork) are expected to significantly improve the status of the Middle Fork Willamette population. Chinook will have access to high quality historical spawning and rearing habitat above the dams and the opportunity for successful spawning, incubation, and rearing in the lower reaches. Resulting juvenile production will emigrate downstream with reduced rates of injury and mortality. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin Chinook as these

[57] Habitat restoration projects may be distributed in the lower reaches of the tributaries with spawning populations and in the mainstem Willamette.

measures become operational. These actions will improve the function of PCEs in designated critical habitat including:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.7; 3.2; 3.3; 4.6; 4.7; 4.8.1; 4.9; 4.12.2; and 7.1.3).

McKenzie Chinook

The McKenzie Chinook population is at moderate risk of extinction. The risk of genetic introgression by hatchery fish and the loss of historical habitat due to blockage by Cougar Dam on the South Fork McKenzie River are two of the key limiting factors identified for this population. Under the Proposed Action, a new adult collection facility, to be completed by 2010, will allow fish to be collected and transported above Cougar Dam, restoring access to this high quality habitat with reduced rates of stress, injury, and mortality. In addition:

- The RPA will significantly reduce the risk of genetic introgression and competition by hatchery fish in the natural population by limiting hatchery fish straying above Leaburg Dam in the lower McKenzie River.
  - *RPA 6.1.4: complete construction of the adult trap and sorting facility at Leaburg Dam by December 2013 and begin operations by spring 2014.*
- Construction and operation of an adult release site above Cougar Dam will increase upstream passage survival and reduce pre-spawning mortality by minimizing the stress and injury of adult Chinook salmon outplanted above the dam.
  - *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*
- A downstream fish passage facility will be constructed at Cougar Dam to improve juvenile Chinook outmigrant survival
  - *RPA 4.12.1: Initiate planning and make "go/no go" decision by end of 2010; complete construction by 2014, begin operations by 2015*
- The RPA will address the effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flows, and the maintenance of revetments) on downstream habitat
  - *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*

- *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*
- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.[57] Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Screening diversions will remove impediments or barriers to juvenile Chinook migrants
  - *RPAs 3.2 and 3.3: Reclamation will require that existing, new, and renewed contracts for stored water include conditions that protect fish from entrainment into diversions.*
- Adverse effects of the Chinook hatchery program will be minimized.
  - *RPAs 6.1.2 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*
  - *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark and insert coded wire tags into all hatchery Chinook prior to release.*
  - *RPA 6.2.4: cooperate with ODFW to release juvenile hatchery-origin Chinook that are more similar to natural-origin fish.*

These measures (especially the mechanism for efficient removal of hatchery fish from the spawning population above Leaburg Dam, implementation of hatchery reforms per HGMPs, flow management, and improvements in upstream and downstream passage survival at Cougar Dam), are expected to significantly improve the status of the McKenzie River population. Natural-origin Chinook will have access to high quality historical spawning and rearing habitat above Cougar and the opportunity for successful spawning, incubation, and rearing. Juveniles produced above Cougar will emigrate downstream with reduced rates of injury and mortality. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin Chinook as these measures become operational. These actions will also improve the functioning of PCEs in designated critical habitat including:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; and 7.1.3).
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; and 7.1.3).
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.7; 3.2; 3.3; 4.12.1; 6.1.4; and 7.1.3).

Calapooia Chinook

The risk of genetic introgression by hatchery fish interbreeding with those of natural origin and impaired physical habitat from past and/or present land uses are key limiting factors for the Calapooia population, which is at very high risk of extinction.

- Address effects of the Willamette Project (specifically, maintenance of revetments) on habitat in the mainstem and Willamette tributaries
  - *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.[57] Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*
- Adverse effects of the Chinook hatchery program will be minimized.
  - *RPAs 6.1.1 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*
  - *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark and insert coded wire tags into all hatchery Chinook prior to release.*

Implementation of the hatchery measures will increase the genetic diversity of Chinook spawning in the Calapooia River and will lead to increased abundance and productivity over time. Because the RPA does not require that habitat projects be located within the Calapooia subbasin, NMFS does not assume that this RPA measure will improve the status of this Chinook population or the functioning of PCEs in the Calapooia subbasin.

South Santiam Chinook

The loss of access to historical habitat above Foster and Green Peter dams and the risk of genetic introgression by hatchery fish interbreeding with those of natural origin, especially in the lower South Santiam below Foster Dam, are key limiting factors for this population, which is at very high risk of extinction.

- The RPA requires rebuilding of the collection facility at the base of Foster Dam to allow better capture and handling of Chinook for outplanting into historically accessible habitat above the dam.
  - *RPA 4.6: complete construction of the new adult collection and handling facilities at Foster Dam by December 2013 and begin operations by March 2014.*
- Construction and operation of new adult release sites above Foster Dam will increase upstream passage survival and reduce pre-spawn mortality by minimizing stress and injury of adult Chinook salmon outplanted above the dams.
  - *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*
- The RPA addresses the long-term need to improve reservoir and dam passage survival at Foster Dam for juvenile Chinook throughout the juvenile migration period.

- *RPA 4.13: The Action Agencies will evaluate a range of potentially beneficial actions for listed fish species at Project dams and reservoirs, including Foster, in their development of the Willamette Configuration and Operation Plan (COP). This will include facilities and operations that require detailed study including feasibility studies and environmental permitting such as long-term fish passage solutions at Foster Dam.*

- Interim operational measures at Green Peter and Foster dams will help to restore more normative seasonal water temperatures

- *RPA 5.1: Identify interim measures by March 2010*

- *RPA 5.1.3: Evaluate more complex measures (required detailed environmental review, permits, and/or congressional authorization) by April 2011*

- The RPA will address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flow patterns, and the maintenance of revetments) on downstream habitat

- *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*

- *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*

- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Screening diversions will remove impediments or barriers to juvenile Chinook migrants

- *RPAs 3.2 and 3.3: Reclamation will require that existing, new, and renewed contracts for stored water include conditions that protect fish from entrainment into diversions.*

- Adverse effects of the Chinook hatchery program will be minimized.

- *RPAs 6.1.2 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*

- *RPA 4.6: improve fish collection facility at Foster Dam (begin construction by December 2013 and begin operations by March 2014).*

- *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark, and insert coded wire tags into all hatchery Chinook prior to release*

- *RPA 6.2.4: cooperate with ODFW to release juvenile hatchery-origin Chinook that are more similar to natural-origin fish.*

These measures (especially the mechanism for efficient removal of hatchery fish from the spawning population above Foster Dam, implementation of hatchery reforms per HGMPs, flow management, and improvements in downstream passage survival at Foster Dam) are expected to significantly improve the status of the South Santiam population. Natural-origin Chinook will

have the opportunity for successful spawning, incubation, and rearing in the reach above Foster and juveniles will emigrate downstream with reduced rates of injury and mortality. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin Chinook as these measures become operational. These actions will also improve the functioning of PCEs in designated critical habitat including:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.7; 3.2; 3.3; 4.6; 4.7; 4.13; and 7.1.3).

North Santiam Chinook

The loss of access to historical habitat above Big Cliff and Detroit dams, poor natural production below the dams, and the risk of genetic introgression by hatchery fish interbreeding with those of natural origin are key limiting factors for this population, which is at very high risk of extinction.

- The RPA provides measures that will improve upstream passage survival by building a new adult collection facility to replace the trap at the Minto barrier dam, allowing the capture and handling of Chinook for outplanting above Big Cliff/Detroit dams with reduced levels of stress, injury, and mortality.

– *RPA 4.6: complete construction of the new adult collection and handling facilities in North Santiam by December 2012 and begin operations by March 2013.*

- Construction and operation of new adult release sites above Detroit Dam will increase upstream passage survival and reduce pre-spawn mortality by minimizing stress and injury of adult Chinook salmon outplanted above the dams.

– *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*

- Downstream passage improvements at Detroit Dam and Reservoir will increase juvenile Chinook survival and increase the number of smolts emigrating from the population. Combined with RPA 4.6, above, this measure is expected to increase the abundance, productivity, and spatial structure of the North Santiam Chinook population.

– *RPA 4.12.3: initiate planning by 2015, make "go/no go" decision by end of 2017; complete construction by end 2023, begin operations by March 2024.*

- The RPA requires implementation of interim temperature control using existing facilities. This action will provide immediate survival benefits, significantly reducing the problem with the altered water temperature regime in natural production areas downstream of Detroit/Big Cliff dams until a Water Temperature Control facility or alternative solution is implemented. Normative water temperatures, particularly during the critical egg incubation period in late fall, will improve the abundance and productivity of the population.

- *RPA 5.1.1: identify and evaluate interim operational measures at Detroit Dam and, if feasible, begin implementation in Water Year 2009.*
- *RPA 5.2: make structural modifications or major operational changes at Detroit Dam for improved water quality, initiating planning by 2010, completing construction by December 2018, and beginning operations by March 2019.*

- The RPA will address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flow patterns, and the maintenance of revetments) on downstream habitat
  - *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*
  - *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*
  - *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.[57] Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*
- Screening diversions will remove impediments or barriers to juvenile Chinook migrants
  - *RPAs 3.2 and 3.3: Reclamation will require that existing, new, and renewed contracts for stored water include conditions that protect fish from entrainment into diversions.*
- Adverse effects of the Chinook hatchery program will be minimized.
  - *RPAs 6.1.1 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*
  - *RPA 4.6: build new fish collection facility in the North Santiam (begin construction by December 2012 and begin operations by March 2013).*
  - *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark and insert coded wire tags into all hatchery Chinook prior to release.*
  - *RPA 6.2.4: cooperate with ODFW to release juvenile hatchery-origin Chinook that are more similar to natural-origin fish.*

These measures (especially implementation of hatchery reforms per HGMPs, providing safe upstream and downstream passage at Big Cliff/Detroit dams, flow management, and improvements in water temperature below Big Cliff Dam) are expected to significantly improve the status of the North Santiam population. Natural-origin Chinook will have the opportunity for successful spawning, incubation, and rearing in the reach above Detroit and juveniles will emigrate downstream with reduced rates of injury and mortality. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin Chinook as these measures become operational. These actions will also improve the functioning of PCEs in designated critical habitat including:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; 5.1.1; 5.2; and 7.1.3).
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; 5.2; and 7.1.3).
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.7; 3.2; 3.3; 4.7; 4.12.3; and 7.1.3).

Molalla Chinook

Genetic introgression of an out-of-basin hatchery stock and impaired physical habitat for past and/or present land uses are key limiting factors for this population, which is at very high risk of extinction.

- The RPA will address effects of the Willamette Project (specifically, maintenance of revetments) on habitat in the mainstem and Willamette tributaries

– *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- The RPA will eliminate use of the current out-of-basin hatchery stock and replacement over time with a locally-derived broodstock. This hatchery reform action will promote local adaptation within the population.

– *RPAs 6.1.1 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*

– *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark and insert coded wire tags into all hatchery Chinook prior to release.*

– *RPA 6.2.5: support ODFW efforts to eliminate use of non-local Chinook stock and to develop locally-adapted broodstock.*

Implementation of the hatchery RPA measures will increase the genetic diversity of Chinook spawning in the Molalla River and will lead to increased abundance and productivity over time. Because the RPA does not require that habitat projects be located in the Molalla subbasin, NMFS does not assume that this RPA measure will improve the status of this Chinook population or the functioning of PCEs in the Molalla subbasin.

Clackamas Chinook

The risk of genetic introgression by hatchery fish interbreeding with those of natural origin and impaired physical habitat from past and/or present land uses are limiting factors for the Clackamas spring Chinook population, which is at moderate risk of extinction.

- Address effects of the Willamette Project (specifically, maintenance of revetments) on habitat in the mainstem and Willamette tributaries

- *RPA 7.1.3: implement at least tow habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.[57] Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Adverse effects of the Chinook hatchery program will be minimized.

- *RPAs 6.1.1 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*

- *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark and insert coded wire tags into all hatchery Chinook prior to release.*

Implementation of the hatchery measures will increase the genetic diversity of Chinook spawning in the Clackamas River and will lead to increased abundance and productivity over time. Because the RPA does not require that habitat projects be located within the Clackamas subbasin, NMFS does not assume that this RPA measure will improve the status of this Chinook population or the functioning of PCEs in the Clackamas subbasin.

All UWR Chinook Populations

The following RPA actions, located or affecting conditions within the mainstem Willamette, will affect all populations of UWR Chinook salmon.

- RPA 2.3: obtain NMFS' approval before changing mainstem Willamette (Albany and Salem) flow objectives, to ensure that flow-related habitat needs of UWR Chinook for rearing and juvenile and adult migrations are fully considered.

- Address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows and the maintenance of revetments) on downstream habitat.

- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.[57] Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Ensure that the availability of adequate water for fish and habitat protection in the tributaries and in the mainstem Willamette is not precluded by the water contract program

- *RPA 3: Reevaluate the availability of water from conservation storage for the water contract program and reinitiate consultation if future irrigation demands exceed 95,000 acre-feet.*

These actions will improve the functioning of PCEs in designated critical habitat:

- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (specifically RPA measures 2.3; 7.1.1; and 7.1.3).

- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.3; 7.1.1, and 7.1.3).

9.11.1.3 Conclusions—UWR Chinook Salmon

9.11.1.3.1 Jeopardy Analysis

The beneficial effects of the RPA (see above), which includes the Proposed Action (Chapters 5 and 7), combined with recent improvements in project facilities and operations (Chapter 4), is expected to address the harm to UWR Chinook caused by the Project. The RPA is designed to increase the abundance, productivity, spatial structure and diversity of the natural-origin Middle Fork Willamette, McKenzie, and South and North Santiam Chinook populations and to increase the genetic diversity of the Calapooia, Molalla, and Clackamas populations. The loss of access to historical habitat will be ameliorated by the rebuilding of fish collection facilities below Fall Creek, Dexter, Foster, and Big Cliff dams to allow significantly safer capture, handling, and transport of Chinook for release above the Project dams. Downstream passage facilities will be constructed for three populations (Middle Fork, McKenzie, and North Santiam) to provide significantly higher survival of emigrating Chinook than under either current operations or the Proposed Action. Interim and long-term water temperature control operations in the North Santiam River will improve altered water temperatures that have depressed natural production in the habitat below the dams. Hatchery reform actions will limit the risk of genetic introgression into the natural-origin populations, promoting life-history diversity and increasing the abundance and productivity of each population. Increases in the viability of these populations will contribute to increases in the status, lowering the risk of extinction, of the ESU as a whole.

Although the RPA measures combined with the Proposed Action will be implemented over the 15-year term of the Opinion and some of the biological benefits will take even longer to accrue, a number of measures will provide benefits in the short-term, reducing the ESU's short-term risk of extinction. Specifically, project operations have had a key role in degrading habitat conditions downstream, which in the North and South Santiam, South Fork McKenzie, and Middle Fork Willamette are the only areas accessible to Chinook for spawning, incubation, and early rearing. The Action Agencies began new reservoir operations in 2000 to meet mainstem and tributary flow objectives for listed fish. These, and operations that began in 2005 at the new Water Temperature Control facility at Cougar Dam, are already able to have a positive influence on adult returns. By spring of 2009, interim temperature control operations at Detroit will improve water temperatures in the North Santiam, increasing the survival of eggs, juveniles, and prespawning adults and thus population productivity. All of these measures will reduce extinction risk in the short-term as well as contributing to long-term viability. The Action Agencies will adapt their operations to new information on physical habitat properties, including those related to climate change, as the information becomes available over the next 15 years (Section 5.1.7).

The hatchery program for UWR Chinook acts as a safety net for most of the affected populations, reducing the short-term risk of extinction. Under the RPA and Proposed Action, the Action Agencies will cooperate with ODFW in continuing the transition from the historical supplementation programs to conservation/supplementation programs that focus on building genetic diversity using local broodstocks. As part of this effort, the Action Agencies will complete construction of a new sorting facility at Leaburg Dam by 2013. ODFW will use the new facility to prevent hatchery-origin Chinook from interbreeding with natural-origin fish above Leaburg. This will preserve the genetic diversity of fish in an important natural production area, another buffer against short-term extinction.

Reclamation will immediately improve its water contracting program. All (existing, new, and renewed) contracts will be subject to the availability of water, and when there is not enough water to meet minimum flow targets and irrigation contracts, instream flows will be preserved. All contracts will require that irrigation intakes and diversion dams be screened to preclude entrainment and all existing water diversions served by existing water contracts will be screened by April 1, 2010. The headgate requirement will ensure that water diversions can be stopped when not needed, or when directed by OWRD. Particularly during deficit water conditions, this reform will preserve instream flows for fish habitat needs.

The Action Agencies will continue to outplant adult UWR Chinook salmon above Detroit (North Santiam); Foster (South Santiam); Cougar (McKenzie); and Lookout Point, Hills Creek, and Fall Creek dams (Middle Fork Willamette population), an operation that enhances spatial structure in the short term while long-term passage facilities are developed. The outplanting program will be managed according to an annual Fish Operations Plan, coordinated with the Services and ODFW, which will address how, where, and when outplanted fish will be collected, held, marked, sampled, transported, and released, and will incorporate changes needed to further protect these fish based on research and monitoring.

The Action Agencies will also begin to upgrade existing adult fish collection and handling facilities in the first half of the term of the Opinion. Dates for beginning operations at the new facilities are March 2013 in the North Santiam, 2014 at Foster Dam (South Santiam), 2015 at Dexter Ponds, and 2016 at Fall Creek Dam (Middle Fork Willamette). Once construction is complete, adult fish will experience reduced levels of stress and injury, which is expected to lessen pre-spawning mortality. Completion of these facilities will also help ensure that broodstock targets are met.

The Action Agencies will design and begin to use new adult release sites above the dams by 2012. These new sites, like the improved adult collection facilities, will reduce stress and injury and thus the risk of prespawning mortality.

In addition to these measures, which will immediately (during the first one-to-seven years of this Opinion) improve population viability and reduce the risk of extinction, the RPA requires that the Action Agencies complete various RM&E efforts, feasibility studies, and where needed, NEPA analysis. NMFS expects that these evaluations will lead to the construction of facilities and adjustments in operations during the second half of the term of this Opinion that will ensure that conditions are optimized for all affected life stages of UWR Chinook. These will include:

- Adjustments to mainstem and tributary flow objectives and ramping rates to meet the needs of the species over all affected life stages
- Operations for water quality (temperature and dissolved gas) and construction of new facilities
- Construction of additional juvenile passage facilities
- Full implementation of the habitat restoration program
- Adaptation of flow management and water quality measures to changing climatic conditions

The near- and longer-term RPA measures described above will address the effects of the Willamette Project that are detrimental to all life stages of UWR Chinook that occur within the

Willamette Basin: adult migration and holding, spawning and incubation, juvenile rearing, and emigration.

Other measures taken by the same Action Agencies under the environmental baseline (as required by the 2008 FCRPS RPA; NMFS 2008a) will improve the survival and condition of juvenile UWR Chinook in the lower Columbia River and estuary. The effects of the Willamette Project on habitat are very small in the lower Columbia and estuary, with slight to negligible adverse effects on viability (Section 5.11). However, the FCRPS RPA includes beneficial measures to reduce smolt predation by Caspian terns and Northern pikeminnows and a significant estuary habitat restoration program to ensure that biological requirements are met. These actions will benefit both yearling and subyearling Chinook from the Willamette Basin during the critical period prior to ocean entry.

After reviewing the effects of the RPA measures combined with the Proposed Action, which address significant adverse impacts of the Willamette Project (lack of effective passage, degraded water quality and physical habitat properties, and adverse effects of hatchery practices on population viability), the rangewide status of the species, the effects of the environmental baseline (UWR Chinook limited to significantly degraded habitat in several important subbasins), and cumulative effects (reasonably certain non-federal activities intended to benefit the status of the species mixed with those likely to have adverse effects), NMFS has determined that the UWR Chinook salmon ESU is expected to survive with an adequate potential for recovery. The actions that will be implemented in the first few years, including reforms to the Hatchery Mitigation Program, will protect the species against the short-term risk of extinction while longer-term measures are designed and constructed. NMFS therefore concludes that the RPA and Proposed Action, combined, are not likely to jeopardize the continued existence of the UWR Chinook salmon ESU.

9.11.1.3.2 Critical Habitat Analysis

The measures described in the RPA combined with the Proposed Action will also improve the functioning of primary constituent elements of habitat needed for the conservation of the species, restoring the ability of designated critical habitat affected by the Project to serve its conservation role. The actions described above will significantly improve the following PCEs over the term of the Opinion:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival

In the first one-to-seven years, the Action Agencies will rebuild the adult Chinook collection facilities and will build new release sites above Project dams. These measures will provide safe passage to high quality freshwater spawning sites with water quantity and quality and substrate that support spawning, incubation, and larval development. A new downstream passage facility at Cougar will also become operational during this period, further improving passage conditions for juvenile Chinook. Ongoing operations to meet flow objectives in the Middle Fork

Willamette, McKenzie, and South and North Santiam rivers, and operations that preserve instream flows during deficit water conditions will ensure adequate water quantity in spawning, rearing, and early migration areas. The Action Agencies will implement interim temperature control operations at Detroit Dam in the North Santiam to provide water quality needed for adult migration, spawning and incubation, and juvenile and kelt downstream survival. All existing water diversions will be screened by April 1, 2010, also contributing to safe passage in the juvenile migration corridor.

The actions to be implemented in second half of the term of this Opinion will continue these trends, restoring the functioning of safe passage for juveniles and kelts in the North Santiam and of water quality in the South Santiam. Full implementation of the habitat restoration program will ensure that habitat affected by Project operations can serve its conservation role for the species.

After reviewing the effects of the RPA combined with the Proposed Action, the status of the species, the environmental baseline, and cumulative effects, NMFS has determined that the functioning of critical habitat is likely to improve and to remain functional. NMFS therefore concludes that the Proposed Action and the RPA, combined, are not likely to result in the destruction or adverse modification of designated critical habitat for UWR Chinook salmon.

9.11.2 UWR Winter Steelhead

9.11.2.1 Effects of the RPA

The RPA specifies many significant measures that will reduce the adverse effects of the Willamette Project on the UWR steelhead DPS and will bring about proper functioning of primary constituent elements (PCEs) of its critical habitat. Many of the RPA measures specifically address key limiting factors/threats facing each population and caused by the Willamette Project: lack of passage, the degraded quality of the remaining habitat downstream of the dams, and the risk of genetic introgression from out-of-ESU hatchery fish spawning in the wild. By implementing the RPA, it is very likely the status of the populations in the North and South Santiam rivers, designated core populations (see Chapter 3), will improve significantly. . With implementation of the RPA, NMFS expects that the status of the DPS, including the four VSP parameters, will improve significantly compared to their potential status under the Proposed Action.

As shown in Table 9.11-1, several major RPA measures will be completed between 2015 and 2024 including passage at Detroit Dam, which will provide access to and from historical habitat that is currently blocked and temperature control to improve downstream habitat in a different location. Most of these measures are major construction projects that take a significant amount of time to plan, fund, and execute. For a full description of the authorization and funding processes needed for these types of measures, see the Supplemental Biological Assessment (USACE 2007I). It is not economically and technically feasible to move the timelines for many of these measures forward significantly due to their magnitude and the time needed for studies, design, authorization and construction.

Given these constraints, the anticipated population status improvements will begin in the next 15 years and continue to increase over the 15-year term of this Opinion. It will take several generations of the steelhead life cycle to respond to the positive improvements in the operation

of the Willamette Project and associated measures. Therefore, significant improvements in the status of the DPS will continue to accrue in the next 30 years (approximately six generations). While implementation of these RPA measures will occur during the term of this Opinion, their full effects on population metrics (e.g., abundance, productivity) will occur over a considerable period of time after implementation. Therefore, NMFS expects that substantial improvements to the ESU will result from the implementation of the Proposed Action and the RPA.

In addition to the major measures specified in Table 9.11-1, there are numerous other near-term measures such as changes to flow, screening irrigation diversions, hatchery program modifications, and habitat mitigation projects that are included in the RPA. The near-term measures in Table 9.11-1 directly address project effects on listed fish and critical habitat without requiring as many years to implement as the measures discussed above. A third group of measures, such as conducting RM&E studies, developing fish operations manuals, project planning, and implementing the WATER collaborative process, will begin in the near term. Although this third group of activities also has not been included in the summary table, these are essential tasks that will facilitate construction of the large structures as well as guide annual operations, all of which will benefit UWR steelhead.

Difference between the Proposed Action and RPA

The effect of the RPA measures on UWR steelhead is significantly different than the effect of the Proposed Action. The Proposed Action mainly provided for further studies to consider options such as passage facilities to historical upstream habitat, as well as a major downstream habitat improvement measure of temperature control. In addition, the RPA includes measures to improve degraded downstream habitat through changes to flows, screens at irrigation diversions, hatchery improvements, and other habitat improvement projects. These RPA measures are significant because UWR steelhead are currently limited to degraded downstream habitat in one of the important subbasins (North Santiam). The RPA measures both provide access to higher quality habitat and improve downstream habitat conditions, which together will provide significant enough improvements to allow the UWR steelhead DPS to increase in numbers, productivity, spatial structure, and diversity.

9.11.2.2 UWR Steelhead Populations—Summary of Effects of the RPA

The following is a population-by-population summary of the benefits of the RPA on UWR steelhead populations. It is important that this section be read in the context of Chapter 7, "Summary of Effects of the Proposed Action on UWR Chinook and Steelhead."

Calapooia Steelhead

Impaired physical habitat from past and/or present land uses is a key limiting factor for the Calapooia population, which is at a moderate risk of extinction.

- Address effects of the Willamette Project (specifically, maintenance of revetments) on habitat in the mainstem and Willamette tributaries

- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use*

project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.

Because the RPA does not require that habitat projects be located within the Calapooia subbasin, NMFS does not assume that this RPA measure will improve the status of this steelhead population or the functioning of PCEs in the Calapooia subbasin.

South Santiam Steelhead

Competition with hatchery-origin summer steelhead smolts, inadequate passage facilities at Foster and Green Peter dams, and degraded habitat downstream of Foster Dam are key limiting factors for this population, which is at moderate risk of extinction.

- The RPA will reduce impacts associated with the summer steelhead hatchery program.
  - *RPA 6.1.6: reduces the risk of residualism by allowing the volitional emigration of hatchery summer steelhead from the point of release over an extended period of time and removing non-migrants from the system.*
  - *RPA 6.1.7: ends the recycling of hatchery-origin summer steelhead for harvest purposes by September 1st of each year to decrease the risk of straying and spawning in the wild.*
  - *RPA 6.1.8: adjusts the releases of summer steelhead in the Santiam basin. More summer steelhead are caught by recreational fishers in the South Santiam, but a disproportionate number of smolts are released in the North Santiam. Aligning releases with fishery needs will reduce the risk of competition with listed winter steelhead for spawning sites.*
  - *RPA 6.1.9: ensures that the Action Agencies will cooperate with ODFW to reduce the risks to winter steelhead of straying and spawning of summer steelhead based on information acquired through research and monitoring.*
- The RPA requires rebuilding of the adult collection facility at the base of Foster Dam to allow better capture and handling of winter steelhead for outplanting into historically accessible habitat above the dam.
  - *RPA 4.6: complete construction of adult fish collection and handling facilities at Foster by December 2013 and begin operations by March 2014.*
- Construction and operation of one or more new adult release sites above Foster Dam will increase upstream passage survival and reduce pre-spawn mortality by minimizing stress and injury of adult steelhead outplanted above the dam.
  - *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*
- The RPA addresses the long-term need to improve reservoir and dam passage survival at Foster Dam for juvenile steelhead and kelts.
  - *RPA 4.13: The Action Agencies will evaluate a range of potentially beneficial actions for listed fish species at Project dams and reservoirs, including Foster, in their development of the Willamette Configuration and Operation Plan (COP). This will include facilities and operations that require detailed study including feasibility studies and environmental permitting such as long-term fish passage solutions at Foster Dam.*

- The RPA requires continuation of the spill program for juvenile steelhead passage at Foster Dam, which provides better passage survival that turbine passage

– *RPA 2.8: continuation of spill for juvenile steelhead passage at Foster from April 15 to May 15 each year*

- Interim operational measures at Green Peter and Foster dams will help to restore more normative seasonal water temperatures

– *RPA 5.1: identify interim measures by March 2010*

– *RPA 5.1.3: evaluate more complex measures (requiring detailed environmental review, permits, and/or congressional authorization) by April 2011.*

- The RPA will address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flow patterns, and the maintenance of revetments) on downstream habitat.

– *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*

– *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*

– *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Unscreened diversions create impediments or barriers to juvenile steelhead migrants.

– *RPAs 3.2 and 3.3.: Reclamation will require that existing, new, and renewed contracts for stored water include conditions that protect fish from entrainment into diversions.*

These measures (especially the hatchery program improvements and increases in downstream passage survival at Foster Dam) are expected to significantly improve the status of the South Santiam steelhead population. Natural-origin winter steelhead are already collected at Foster and released upstream, but the RPA will ensure that these operations and juvenile and kelt movements downstream entail less injury, mortality, and stress. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin steelhead as these measures become operational. These actions will also improve the functioning of PCEs in designated critical habitat including:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).

- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).

- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.7; 2.8; 3.2; 3.3; 4.6; 4.7; 4.13; and 7.1.3).

North Santiam Steelhead

Competition with hatchery-origin summer steelhead smolts, loss of access to historical habitat above Detroit Dam, and altered habitat downstream of Big Cliff Dam are key limiting factors for this population, which is at moderate risk of extinction.

- The RPA will reduce impacts associated with the summer steelhead hatchery program.
  - *RPA 6.1.6: reduces the risk of residualism by allowing the volitional emigration of hatchery fish from the point of release over an extended period of time and removing non-migrants from the system.*
  - *RPA 6.1.7: ends the recycling of hatchery-origin summer steelhead for harvest purposed after September 1st of each year to decrease the risk of straying and spawning in the wild.*
- The RPA will significantly reduce the problem with altered water temperatures released from Detroit/Big Cliff dams in natural production areas downstream by requiring the Action Agencies to construct a Water Temperature Control Facility, or alternative operational measures, at Detroit Dam.
  - *RPA 5.1.1: identify and evaluate interim operational measures at Detroit and if feasible, begin implementation in Water Year 2009.*
  - *RPA 5.2: make structural modifications or major operational changes at Detroit Dam for improved water quality, initiating planning by 2010, completing construction by December 2018, and beginning operations by March 2019.*
- The RPA addresses the potential need to provide upstream adult passage at Detroit and Big Cliff dams. Replacing Minto Trap will allow for capture and handling of steelhead for outplanting, if determined necessary, with reduced levels of stress, injury, and mortality.
  - *RPA 4.2: If determined necessary by NMFS, in coordination with the FPHM (WATER subcommittee), the Action Agencies will collect adult steelhead at the Minto trap and release them above Detroit and/or Big Cliff dams.*
- Construction and operation of new adult release sites above Detroit Dam will increase upstream passage survival and reduce pre-spawn mortality by minimizing stress and injury of adult Chinook salmon outplanted above the dams.
  - *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*
- The RPA addresses the potential need to provide downstream juvenile steelhead and kelt passage at Detroit and Big Cliff dams if NMFS determines that steelhead should be outplanted above Detroit Dam.
  - *RPA 4.12.3: initiate planning by 2015, make "go/no go" decision by end of 2017; complete construction by end of 2023, begin operations by March 2024.*
- The RPA will address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flow patterns, and the maintenance of revetments) on downstream habitat

- *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*
- *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*
- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.[57] Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

These measures, especially the hatchery program improvements, providing safe upstream/downstream passage at Big Cliff/Detroit dams, and improvements in water temperatures below Big Cliff Dam, are expected the significantly improve the status of the North Santiam population. Natural-origin steelhead will have the opportunity for successful spawning, incubation, and rearing in the reach above Detroit and juveniles will emigrate downstream with reduced rates of injury and mortality. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin winter steelhead as these measures become operational. These actions will also improve the functioning of PCEs in critical habitat:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; 5.1.1; 5.2; and 7.1.3).
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; 5.1.1; 5.2; and 7.1.3).
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 3.2; 3.3; 4.2; 4.6; 4.7; 4.12.3; and 7.1.3).

Molalla Steelhead

Insufficient streamflows due to land use-related water withdrawals resulting in impaired water quality and reduced habitat availability and impaired physical habitat from past and/or present land use practices are secondary limiting factors for this population, which is at a moderate risk of extinction.

- The RPA will address effects of the Willamette Project (specifically, maintenance of revetments) on habitat in the mainstem Willamette and tributaries.
- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.[57] Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

Because the RPA does not require that habitat projects be located in the Molalla subbasin, NMFS does not assume that this RPA measure will improve the status of this steelhead population or the functioning of PCEs in the Molalla subbasin.

All UWR Steelhead Populations

The following RPA actions, located. or affecting conditions within the mainstem Willamette, will affect all populations of UWR steelhead.

- RPA 2.3: obtain NMFS' approval before changing mainstem Willamette (Albany and Salem) flow objectives, to ensure that flow-related habitat needs of UWR steelhead for rearing and juvenile and adult migration are fully considered.
- Address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows and the maintenance of revetments) on downstream habitat
- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*
- Ensure that the availability of adequate water for fish and habitat protection in the tributaries and in the mainstem Willamette is not precluded by the water contract program.
- *RPA 3: Reevaluate the availability of water from conservation storage for the water contract program and reinitiate consultation if future irrigation demands exceed 95,000 acre-feet.*

These actions will improve the functioning of PCEs in designated critical habitat:

- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (specifically RPA measures 2.3; 7.1.1; and 7.1.3).
- Freshwater rearing corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.3; 7.1.1, and 7.1.3).

9.11.2.3 Conclusions—UWR Steelhead

9.11.2.3.1 Jeopardy Analysis

The risk of extinction for the four UWR steelhead populations is moderate and the improvements in conditions that will result from the RPA and Proposed Action, combined with recent improvements in project facilities and operations (Chapter 4), will address limiting factors caused by the Project. The RPA is designed to increase the abundance and productivity of the South and North Santiam populations, to increase the spatial structure (geographic range) of the North Santiam population, and to improve the diversity (locally adapted genotypes) of all four populations (including the Calapooia and Molalla). The relationship between the RPA improvements, population viability, and the risk of extinction is similar to that described in Section 9.11.1.3 for UWR Chinook salmon, with a few differences. The Action Agencies are already passing winter steelhead upstream of Foster Dam, but the RPA requires that the adult collection facility be rebuilt to allow safer capture, handling, and transport to will increase the survival and therefore productivity of the outplanted fish. The downstream passage facilities, used by both juvenile steelheads and kelts, also will be improved to increase survival. Interim and long-term water temperature control operations in the North Santiam River and ongoing reservoir management to meet flow objectives will improve conditions that have depressed natural production below the dams and contributed to the populations' moderate risk of extinction. Hatchery reforms will reduce competitions for spawning sites with out-of-basin

summer steelhead and the risk of genetic introgression, promoting life history diversity and increasing the abundance and productivity of each population.

Measures implemented in the first half of the term of this Opinion will further reduce the species' risk of extinction. These include operations to meet mainstem and tributary flow objectives, which were initiated in 2000 and are beginning to positively influence adult returns. These will continue under the RPA and Proposed Action. The Action Agencies will conduct flow studies to ensure that the flow objectives are adequate, based on gauging stations they will establish or improve. By January 2011, the Action Agencies will have determined whether the Opinion's flow levels should be revised to better meet the species needs and will meet any revised flow objectives to the extent possible given all project purposes. Thus, the Action Agencies will improve their operations, reducing negative effects on the listed species and their critical habitat, and will adapt their operations to new information on physical habitat properties, including those related to climate change (Section 5.1.7).

Reclamation will immediately improve its water contracting program. All (existing, new, and renewed) contracts will be subject to the availability of water, and when there is not enough water to meet minimum flow targets and irrigation contracts, instream flows will be preserved. All contracts will require that irrigation intakes and diversion dams be screened to preclude entrainment (fish sucked into irrigation diversions) and the headgate requirement will ensure that water diversions can be stopped when not needed, or when directed by OWRD. These reforms will minimize fish entrainment and, particularly during "deficit" water conditions, preserve instream flows for fish habitat needs. In addition, all existing water diversions served by water contracts will be screened to prevent entrainment by April 1, 2010.

In the short-term, the Action Agencies will continue to pass adult UWR steelhead above Foster on the South Santiam to enhance spatial structure. Fish survival and productivity will be improved by the outplanting program, managed according to an annual Fish Operations Plan that are coordinated with the Services and ODFW and which will address how, where, and when outplanted fish will be collected, held, marked, sampled, transported, and released, and will incorporate changes needed to further protect these fish based on research and monitoring.

By spring of 2009, interim temperature control operations at Detroit will improve water temperatures in the North Santiam, increasing the survival of eggs, juveniles, and prespawning adults and thus population productivity. The Action Agencies will design and begin to use new adult release sites above the dams by 2012. These new sites, like the improved adult collection facilities, will reduce stress and injury and thus the risk of prespawning mortality.

The Action Agencies will also begin to upgrade existing adult fish collection and handling facilities in the first half of the term of the Opinion. Dates for beginning operations at the new facilities are March 2013 in the North Santiam and 2014 at Foster Dam (South Santiam. Once construction is complete, adult fish will experience reduced levels of stress and injury, which is expected to lessen pre-spawning mortality.

In addition to these measures, which will immediately (during the first one-to-seven years of this Opinion) improve population viability and reduce the risk of extinction, the RPA requires that the Action Agencies complete various RM&E efforts, feasibility studies, and where needed, NEPA analysis. NMFS expects that these evaluations will lead to the construction of facilities and adjustments in operations during the second half of the term of this Opinion that will ensure that conditions are optimized for all affected life stages of UWR steelhead. These will include:

- Adjustments to mainstem and tributary flow objectives and ramping rates to meet the needs of the species over all affected life stages
- Operations for water quality (temperature and dissolved gas) and construction of new facilities
- Construction of improved juvenile and kelt passage facilities
- Full implementation of the habitat restoration program
- Adaptation of flow management and water quality measures to changing climatic conditions

The near- and longer-term actions described above will address the effects of the Willamette Project on all life stages of UWR steelhead that occur within the Willamette Basin: adult migration, spawning and incubation, juvenile rearing, and juvenile and kelt downstream migrations.

Other measures taken by the Action Agencies under the environmental baseline (as required by the 2008 FCRPS RPA; NMFS 2008a) will improve the survival and condition of juvenile UWR Chinook in the lower Columbia River and estuary. The effects of the Willamette Project on habitat are very small in the lower Columbia and estuary, with slight to negligible adverse effects on viability (Section 5.11). However, the FCRPS RPA includes beneficial measures to reduce smolt predation by Caspian terns and Northern pikeminnows, and a significant estuary habitat restoration program to ensure that biological requirements are met. These actions will benefit yearling steelhead from the Willamette Basin during the critical period prior to ocean entry.

After reviewing the effects of the RPA measures combined with the Proposed Action, which address significant adverse impacts of the Willamette Project (lack of effective passage, degraded water quality and physical habitat properties, and adverse effects of hatchery practices on population viability), the rangewide status of the species, the effects of the environmental baseline (degraded spawning and rearing habitat in tributaries below Project dams), and cumulative effects (reasonably certain non-federal activities that are intended to benefit these status of the species mixed with those likely to have adverse effects), NMFS has determined that the UWR steelhead DPS is expected to survive with an adequate potential for recovery. The actions implemented in the first few years will protect the species against the short-term risk of extinction while longer-term measures are designed and constructed. NMFS therefore concludes that the RPA and Proposed Action, combined, are not likely to jeopardize the continued existence of the UWR steelhead DPS.

9.11.2.3.2 Critical Habitat Analysis

The measures described in the RPA combined with the Proposed Action will also improve the functioning of PCEs, restoring the ability of primary constituent elements of habitat needed for the conservation of the species. The actions described above will significantly improve the following PCEs over the term of the Opinion:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development

- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival

In the first one to seven years, the Action Agencies will rebuild the adult steelhead collection facilities and will build new release sites above Project dams. These measures will improve safe passage to high quality freshwater spawning sites that have water quantity and quality and substrate that support spawning, incubation, and larval development. Ongoing operations to meet flow objectives in the South and North Santiam rivers, and operations that preserve instream flows during deficit water conditions will ensure adequate water quantity in spawning, rearing, and early migration areas below the dams. The Action Agencies will implement interim temperature control operations at Detroit Dam in the North Santiam to provide water quality needed for adult migration and holding, spawning and incubation, and juvenile survival. All existing water diversions will be screened by April 1, 2010, also contributing to safe passage in the juvenile migration corridor.

The actions to be implemented in second half of the term of this Opinion will continue these trends, restoring the functioning of safe passage for juveniles in three of the four tributaries with Project dams and of water quality in the Middle Fork and South Santiam. Full implementation of the habitat restoration program will ensure that habitat affected by Project operations can serve its conservation role for the species.

After reviewing the effects of the RPA combined with the Proposed Action, the status of the species, environmental baseline, and cumulative effects, NMFS has determined that the functioning of designated critical habitat is likely to improve and remain functional. NMFS therefore concludes that the Proposed Action and the RPA, combined, are not likely to result in the destruction or adverse modification of designated critical habitat for UWR steelhead.

9.11.3 Snake River, Upper Columbia River, Middle Columbia River, and Lower Columbia River Salmon and Steelhead

As described in Sections 8.3-8.7, NMFS has concluded that, taking into account the current status of 11 species of Interior and Lower Columbia Basin salmon and steelhead and of critical habitat designated for 10 of those species,[58] the condition of the environmental baseline and cumulative effects within the action area, the Proposed Action is not likely to jeopardize the continued existence of any of these species or to destroy or adversely modify critical habitat. Adverse effects of the Proposed Action were limited to a very small decrease in average monthly flows in the lower Columbia River and estuary during February through June and very small reductions in the delivery of turbidity and large wood, trapped behind Project dams. These were expected to result in "slight to negligible" effects on habitat conditions, including the PCEs safe passage in the juvenile migration corridor and water quantity, turbidity, floodplain connectivity, large wood, and natural cover in freshwater/estuarine rearing areas, and on population viability. In addition, NMFS anticipates that habitat conditions in the lower Columbia River and estuary will improve over the term of this Opinion due to relocation of Caspian terns to sites outside Columbia Basin, ongoing control of Northern Pikeminnow predation, and implementation of a 10-year estuary habitat program under the 2008 FCRPS RPA (NMFS 2008a). These future improvements in baseline habitat conditions are expected to exceed the small to negligible

[58] NMFS has not yet designated critical habitat for LCR coho salmon.

adverse effects of the RPA and Proposed Action. Thus, NMFS concludes that the Proposed Action and the RPA are not likely to jeopardize the continued existence of any of these species or to destroy or adversely modify critical habitat.

9.11.4 Southern Resident Killer Whales and Southern DPS of North American Green Sturgeon

After conducting the analyses included as Appendices A and B to this Opinion, NMFS determines that the Proposed Action and the RPA are not likely to adversely affect either species or critical habitat designated for the Southern Resident killer whale.